MAGAZINE

OF

ZOOLOGY AND BOTANY.

ORIGINAL COMMUNICATIONS.

I.—*The Natural History of the British Entomostraca.* By WILLIAM BAIRD, Surgeon. Plates VIII. IX. X. *(Continued from p. 41.)*

IN my former paper, I gave a short general history of the "Entomostraca,"—a brief account of the authors who have noticed them particularly; and some general observations on their habits and manners. I also mentioned some of the various systematic arrangements which have been adopted by different authors, and stated the uncertainty which still exists as to their proper arrangement in a general system. In particular I described the arrangements of Latreille in the last edition of Cuvier's Règne Animal, and of Milne Edwards in his late work on the Crustacea, which latter I proposed adopting. The second volume of M. Edwards's work, however, in which the Entomostraca are to be treated of, not having yet been published, it will be necessary to follow Latreille's method in detail; and thus the first genus which I shall give a monograph of, is the genus "Cyclops:"—

Class.—CRUSTACEA.—Division, ENTOMOSTRACA.
Ord. BRANCHIOPODA—Section, LOPHYROPA—Group, CARCINOIDA.
Genus, CYCLOPS.*

Bibliographical History.—The first notice of any animal of this genus that I am aware of, is to be found in a little work of Stephanus Blancardus, the "Schou-burg der Rupsen, Wormen, Ma'den, &c.," published at Amsterdam, in 1688. His notice of it, however,

* "Class, Crustacea; Sub-Class, Maxillés; Legion, Entomostraca; Order Copépodes."—Milne Edwards.

is very brief, and the figure which he gives is very bad; being barely sufficient to enable us to make out that it is the *Cyclops quadricornis* that it is meant to represent. Leeuwenhoek appears to have been the first to have taken any lengthened or particular notice of the genus. In his "Epistolæ ad Societatem Regiam Anglicam," &c. (*Epistola* 121, *written in* 1699,) he gives a good many details of an insect which he found in fresh water, and whose habits he seems to have studied with considerable attention. He gives a figure of it also, which, though far from being correct, suffices to shew us that his insect is also the *C. quadricornis*. His observations upon it are very interesting, and he discovered amongst other things worthy of note, the great difference there is between the young and old insects, though he did not carry his observations so far as to trace the transformations which take place. In "No. 283 of the Philosophical Transactions, for January and February 1703," the same author gives a description of a polype (the *Hydra viridis* of Muller) growing upon the *Lemna* or duck-weed, which calls forth another paper from an anonymous correspondent in "No. 288 for November and December 1703," in which the writer mentions his having frequently observed the same polype growing upon insects, especially upon "two sorts of the crustaceous kind." These two species of insects, which he states are *monoculous*, he gives figures of, sufficiently correct to shew them to be the *C. quadricornis and Castor*, the first being a tolerable figure, though the second is very indifferent. The same writer also takes notice of a third insect of the same genus, which is much smaller and like a shrimp, but which he could never figure, evidently the *C. minutus*. Baker in his "Microscope, made easy, 1743," makes a few remarks upon these same insects, and copies the figures from the Philosophical Transactions, and in his "Employment for the Microscope, 1764," he publishes a letter from a correspondent, who gives a variety of details with regard to the insect which Leeuwenhoek describes, finds great fault with his figure, but gives a much worse one himself! De Geer in his "Memoires pour servir à l'histoire des Insectes," Vol. vii. published in 1778, is the next author, I believe, who has entered into any details with regard to any of the insects of this genus. He describes at considerable length, and figures with tolerable accuracy, the *C. quadricornis*, and confirms many of Leeuwenhoek's statements with regard to it, particularly the great difference between the old and the young insect. Otho Fridericus Muller,* is the next succeeding author who has particularly noticed this genus. Previous to his time,† with the exception of de-

* Entomostraca, seu Insecta testacea, &c. 1785.

† "Unicum quidem ante annum 1769, quo in *Synopsi Monoculorum* quatuor

tached notices such as I have mentioned above, *one* species only of this genus seems to have been noticed by authors, which, like all the other Entomostraca then known, was arranged, and described under the general name *Monoculus*. He was the first to divide the different animals which figured under this name into distinct genera; and having discovered in the marshes, and on the shores of Denmark and Norway, a variety of species all agreeing in generic characters with each other, he formed them into one distinct genus, and gave the name of *Cyclops* to it. He has given a great many interesting particulars of many of these little creatures, but has fallen into two or three mistakes concerning them, which will be pointed out hereafter. Sometime after Muller, Ramdohr, in 1805, published in his work on the Monoculi* a very correct account of the anatomy, &c. of three of the species of this genus found in fresh water, accompanied with plates, which possess very considerable accuracy; and traces their whole transformation from the egg to the perfect insect. Louis Jurine (pere)† is the last author whom we shall mention, and is the one who, of all that have written upon this class of insects, has given us the fullest, most interesting, and most accurate information upon the fresh water species of this genus; and though he declines the name of *Cyclops*, which Muller had given it, and prefers the old term *Monoculus*, he has cleared up the mistakes which the former has fallen into, and completed, by a series of wonderfully careful experiments, the previous discoveries of Leeuwenhoek and De Geer. He takes no notice of the labours of Ramdohr, and seems to be ignorant of his discoveries, though the work of Ramdohr preceded his by fifteen years.

Anatomy ‡.—In general form and appearance, the genus *Cyclops* approaches nearer to the terminating series of the *Malacostraca*, than do any other of the Entomostraca. § The body of the animal, which is soft and gelatinous, is inclosed within a horny shell, which covers it like a buckler, but opens inferiorly to give issue to the antennæ, organs of the mouth and feet. In general the body and tail are pretty easily to be distinguished from each other, and are composed of about ten segments, the body generally having four, and the tail six. In the upper or *cephalo-thoracic* segment of the body, which

novos Cyclopes fluviatiles publici juris feci, nempe Monoculus quadricornis Entomologis innotuit."—Entomost. p. 100.

* Beyträge zur Naturgeschichte einiger deutschen Monoculus-arten,—4to, Halle, 1805.

† Histoire des Monocles qui se trouvent aux environs de Génêve.–1820.

‡ I have, in a great measure, followed Jurine in the anatomical *nomenclature*, adhering as closely as possible to the *terms* he uses.

§ "Cancris macrouris maxime accedunt structura corporis pedum et antennarum, &c." Muller, p. 100.

is usually much the largest of all, we find the eye, the antennæ, mandibles, mouth, one pair of organs which Jurine calls hands, and one pair of feet. The eye is situated near the upper extremity of this first segment, and in the centre. It is generally pretty large, and is single. In *C. Castor* we can perceive the muscles which move it, and which are pretty numerous; the eye itself is of a beautiful ruby colour. The antennæ are four in number. The superior antennæ arise from the upper portion of the segment, on each side of the eye; they are always larger than the inferior pair, and are generally composed of numerous articulations, which are plentifully supplied with short setæ; the number of articulations differ in each species. The male is distinguished by a peculiarity in the antennæ, which at once marks the sex. In general they are shorter and thicker than in the female, and either one, the *right* one, as in *C. Castor*, or both, as in *C. quadricornis*, &c. have a swelling near the centre, or towards the extremity, followed by a moveable joint, which acts like a hinge, and which serves a very useful purpose in the act of copulation. The inferior antennæ, or antennules, are situated immediately beneath the preceding, and are composed of fewer articulations. Both of these organs are made use of by the animal to assist itself in progressive motion. Immediately below the antennules are the internal mandibles, which may be described as consisting of three parts, body, neck,* and "barbillon," but differing from each other in several respects in the different species. In the *C. quadricornis* are two organs, partly covering these, which Jurine calls external mandibles,† and which do not exist in the other species; and in the *C. Castor* and *minutus* again, are to be seen two round bodies which open and shut during the time the animal is taking food, and which do not exist in the *quadricornis;* these Jurine calls lips. The action of the internal mandibles is to reduce the objects of food when large into small pieces, fitted to pass by these lips into the mouth. Below the mandibles are situate two organs, which Jurine calls hands; a term which Muller had already applied to the same organs in one marine species he describes, the *C. chelifer.* ‡ All the species of the genus possess these organs. They are always situated in the same place; but all differ from each other in so many respects, that it will be necessary to describe them in each species separately. The use of these organs, according to the author I have already quoted so often, is to push constantly towards the mouth a

* Prolongation of Jurine.

† "Mâchoires."—Latreille.

‡ "Entomostraca."—P. 114.

current of water, carrying along with it the particles destined for the insect's food. Immediately beneath the hands are situated the first pair of feet. They are double, consisting of two stalks arising from a common base, each stalk consisting generally of from two to four articulations, more or less furnished with setæ, but varying very much in different species, especially the marine ones. Attached to the next three segments of the body, and arising from the interstices between each, we find three other pairs of double feet, in general resembling each other exactly. These feet act as true fins, and as they are not at all used by the insect for *walking*, the term *feet* is not so correct as that of *fins*. In the tail we find placed the organs of generation and their appendages. In the first segment, we observe in the female two organs, which differ in appearance in each species, and which, as their use is to give support to the oviducts which furnish the envelope of the external ovaries, are called by Jurine, "les supports, ou fulcra." At the junction of the second ring with the third in the same sex, in the *C. quadricornis*, is situate the vulva; this opening forms also the mouth of the *canalis deferens*, which communicates directly with the internal ovary, and gives passage to the eggs. In the male of this species, we find the genital organs situated also in the second segment of the tail, consisting of an oval body or papilla, which gives origin to a prolongation of three short segments. In most of the other species the male organs appear to be situated in the corresponding segment to that in the female, which carries the "fulcra," or "supports." The external ovary, or bag of eggs, springs from where the second segment articulates with the third, and is attached to it by a very slender pedicle. The internal ovaries consist of an opaque mass of solid-looking matter, composed of numerous round globules of a dark brown colour, disposed round the alimentary canal, and occupying a considerable space of the interior of the body. This, as I have already stated, has a direct communication with the opening at the junction of the second with the third segment of the tail, the *canalis deferens* of Jurine; and it is through this canal that the eggs pass into the external ovary. The alimentary canal is very perceptible, beginning behind at the place which I have mentioned as the situation of the lips, and terminating at the extremity of the tail. In the *C. Castor* the heart is very distinctly to be seen under the second and third segment of the body. It is oval, and gives origin to two vessels of equal size, one going to the head, and the other to the tail, and has another organ attached to it, which Jurine considers the auricle. The pulsations of the heart are very frequent, from 112 to 120 in the minute.

Habits, manners, &c.—The insects which belong to this genus are to be found both in the fresh water and the sea. The fresh water species abound in the muddiest, most stagnant pools, and in the clearest springs,—and the ordinary water with which the inhabitants of London are supplied for domestic purposes, contains them often in great numbers. The marine species are to be found, often in immense abundance, in small pools on the sea shore, within high water mark, living amongst the sea weeds and corallines, which frequently fringe so elegantly the beautiful little wells and clear round pools which are hollowed out in the rocks by the sea shore, and are equally abundantly to be met with in the open ocean, where, by the curious luminous properties they possess, they assist in producing that beautiful phosphorescent appearance of the sea, which has so much puzzled naturalists to discover the cause of. It is amazing, when we examine the pools of water which are to be met with in our fields, or sea shores, to find such infinite myriads of little creatures sporting about in all the enjoyment of existence—and it is exceedingly curious and interesting to know the extraordinary fertility of such apparently insignificant creatures. Specimens of the *quadricornis* are often to be met with carrying thirty or forty eggs on each side,* and though the other species which have only one external ovary, do not carry so many, still the number is very considerable. Jurine has with great fidelity watched the hatching and increase of the *quadricornis* in particular, and has given a calculation which shews the amazing fertility of the species. He has seen one female, isolated, lay ten times successively—but in order to be within bounds, he supposes her to lay eight times within three months, and each time only forty eggs. At the end of one year this female would have been the progenitor of 4,442,189,120 young!! The first mother lays forty eggs—which at the end of three months, at eight layings during that time, would give 320 young. Out of this number he calculates 80 as males, (there being in every laying a great proportion of females,) the remaining 240 are females. The following table will then shew the prodigious extent of their fecundity :†

* Leeuwenhoek says, that in the specimens which occurred to him of the *quadricornis*, he counted the eggs to be three or four in breadth and nine or ten in length. Epist. ad. Soc. Reg. Ang. p. 138.

† Jurine, Hist. des. Monoc. &c. p. 32.

	No. of layings.	Time employed for these 8 layings.	Total—each laying supposed to be of 40 young.	Subtract for males.	Females remaining.
1. mother	8	From 1st Jan. to end of Mar.	320	80	240
1. family, of females 240	8	From 1st Apr. to end of June.	76,800	19,200	57,600
2. family, of females 57,600.	8	From 1st July to end of Sep.	18,432,000	4,608.000	13,824,000
3. fam. of fem. 13,824,000.	8	From 1st Oct. to end of Dec.	4,423,680,000	1,105,920,000	3,317,760,000
			4,442,189,120	1,110,547,280	3,331,641,840

A single copulation suffices to fecundate the female for life. The male seems very ardent in his amours. By way of prelude, he seizes hold of the hinder feet of the female with his antenna, which being furnished at its extremity with the hinge joint, already described, forms a fastening round her feet which she cannot unloosen by any exertion—and thus he is carried about with great rapidity for some time. The female, however, at length stops, wearied by her exertions, when the male seizes the favourable moment, and in the twinkling of an eye (as Jurine expresses himself) makes a double copulation—one on each side. According to Muller, the male organs are situated in the swellings which we perceive in one or both antennæ of that sex, and which are characteristic of it. Carried away by the analogy of the *Arachnides*, and seeing the male seize hold of the lower part of the female with his antennæ, he immediately conjectured that the organs resided in the swellings which mark the antennæ of the male, and were applied to the vulva, which he correctly enough states to be situated in the tail.* This mistake, however, Jurine has cleared up, having shown the organs in both sexes, and watched the act of copulation itself. When the mother is about to lay, we may perceive the material of the eggs, which I have described above under the name of internal ovary, divide into two columns, one on each side, and pass through the *canalis deferens*, covered with a fine pellicle, which forms the sac in which the eggs are contained when extruded. This bag of eggs, or external ovary, remains suspended at the tail of the female for several days, varying from two to ten according to temperature of weather, &c.† The eggs themselves during their sojourn there do not increase in

* Entomostraca, p. 16–17.

† Leeuwenhoek says they exclude their ova in the space of one day or night, and bring them to perfection in the space of three days.—(Epist. ad Soc. Reg. Ang,)

size, but undergo various changes in colour, &c. and at the proper time the ovary opens, and the young ones are ushered forth into life, as unlike the parent as can well be imagined. I have already said that Leeuwenhoek had noticed this difference between the young and old, and upon first observing it, he seems to have been much surprised at the unexpected discovery. He repeated his experiment, therefore, of separating an insect with the ova attached to the tail, and found the same result. "Ea hisce visis," he concludes, "certa mihi persuasi ea animalcula, quæ jam oculis meis observabantur, ex ovis illis nata esse."* He watched them for seven or eight days, and found them increased in size—but here, when just on the threshold of discovery, he seems to have stopped, and he makes no farther mention of a continuation of his observations. De Geer also noticed this curious fact—confirms the observations of Leeuwenhoek as far as they went—gives figures of the young at different stages of their growth—but stopped short in his observations also, after having watched them about fifteen days. Notwithstanding this Muller could not persuade himself that such dissimilar creatures could be the same, and he has accordingly, without giving sufficient credit to these illustrious men, or watching the hatching and progress of the young himself, formed these imperfect insects into two different genera, which he has called Nauplius and Amymone.† Ramdohr and Jurine, however, have both clearly rectified this mistake, and fully corroborated the assertions of Leeuwenhoek and De Geer, by following out the transformations in all their extent. The time occupied in this process varies much according to the season of the year, and the temperature. This latter I have found produces an amazing difference in the length of time so occupied, and I have no doubt also, from my experiments, that the process has been retarded or hastened on, according as the vessel in which they have been kept has been placed in a light or a dark situation. According to Jurine, the time occupied in the case of the *C. quadricornis* has never been less

* Epist. ad Soc. Reg. Ang. p. 139.

† Entomostraca, pp. 39–48, Plates i. and ii.—It is stated by Latreille, and echoed by some other writers, that the *Amymone* of Muller is the young of the *Cyclops* in its earliest state, when it has as yet only four legs, and that when it receives the additional pair it then becomes the *Nauplius*. This is not correct. The different species of *Amymone* are the young of the *C. minutus* in different stages, and of one or two of the marine species; and never assume the form of the *Nauplius*. The *Nauplius* (at least the N. saltatorius) is the young of the *C. quadricornis*, which at its earliest stage resembles fig. 3 of plate 1. of Muller. The *N. bracteatus* I have never seen, and do not know.

than twenty days, and in a series of very careful experiments which he made in February and March, he found it to occupy twenty-eight days. For the first eight days, they underwent little or no change —between the eighth and thirteenth the body appeared a little more elongated—between the thirteenth and nineteenth, the line of demarcation between this increase of length and primitive size was traceable by a line of a brown colour, and the insect had acquired a third pair of feet—between the nineteenth and twenty-fifth, no great change took place, only the third pair of feet were more developed—between the twenty-fifth and twenty-eighth the first moulting took place —and thirteen days afterwards they moulted a second time. In a series of experiments which I undertook, upon the same species, in the end of June and beginning of July, when the thermometer was frequently above 80° during the day, I found the time occupied in the process, in some instances, very much shortened. In one brood which were hatched on the 21st of June, I found some had completed their first moulting on the 1st of July, or on the eleventh day. In another brood hatched on 22d June, I found the same result, several of the young having undergone a first moulting on the 2d July. On the 4th I could only see one that had not moulted—and next day, the 5th, this one had also undergone the change: the second moulting in many of them took place only a few days after the first. In another brood hatched a little earlier in June when the weather was not so hot, I found the changes take place as follows: When hatched the insect appeared of an oval shape, (Plate VIII. Fig. 9,) having two thick antennæ of three articulations each; two pairs of feet, bifid at extremity; in the upper pair, one division consisting of two and the other of only one articulation; in the lower, both divisions having only one articulation; extremity of body furnished with two short setæ on each side. On the eighth day, the body is considerably elongated, and a distinction has begun to be perceptible between this increase and original size, with some appearance of setæ where the third pair of feet afterwards appear; intestine very distinct, (Fig. 10.) On the fifteenth day, the third pair of feet have become distinctly formed; the lower part of body more elongated, the elongation marked by another line of demarcation; the setæ on the edges of the antennæ have become visible, and those of the feet longer and more numerous, whilst the second pair of feet have the upper division of two articulations, (Fig. 11.) On the seventeenth day, moulting has taken place—the body is divided into two segments; tail into three; the terminating one cleft at extremity, each cleft sending off a long seta; antennæ of about six articulations; the antennules have become distinctly visible, and the feet have assumed the appearance they after-

wards bear, (Fig. 12.) At each moulting the number of segments into which the body and tail are divided increase in number; the number of articulations and the length of antennæ increase, &c., but it is not till after the third moulting that the insect is perfect and capable of producing its species.*

A question has been started whether the *Cyclops* should be considered oviparous or viviparous insects; and it appears to be one of some difficulty, as they would seem from what I have stated to be both. Geoffroy states that all the *Monoculi* are oviparous.† De Geer also says they are oviparous. "However," he immediately adds, "as the *Monoculi* never quit their eggs before the young ones are hatched, we may perhaps regard them as viviparous."‡ Jurine says it is difficult to decide. Viviparous young, he says, increase in size every day, and have constant need of a mother's care—if she die, all die. As, however, the young of the Cyclops do *not* increase in size after passing from the internal ovary, and as, from numerous experiments which he details, they were found, after having passed into the external ovary, to be independent of the life of the mother, even if she were killed by spirits of wine—they must, he concludes, be considered oviparous. §

The process of moulting, under which the little creature frequently succumbs, is both interesting and curious. The new shell or

* The recent alleged discoveries of Mr Thompson, of the metamorphoses which the young of several genera of the *Cirrhipedes* and *Crustacea* undergo, have excited a good deal of attention of late to this very interesting subject. According to Mr Thompson, the genus Zoea of Bosc, which figures away in many of our arrangements, as one of our Entomostraca, is nothing more nor less than the larva of the common crab, in its first state. (Vide Zoological Researches, No. I. and succeeding.) M. Burmeister has verified Mr Thompson's discoveries with regard to the metamorphoses which the *Cirrhipedes* undergo; but many doubts still continue to be thrown upon his observations with regard to the genera of *Crustacea*. One or two genera of each of the great groups of the *Malacostraca* have been apparently satisfactorily ascertained to undergo no metamorphosis—and the labours of M. Rathke, with the observations of other writers, and especially of Mr Westwood, in a paper published in the Philosophical Transactions for 1835, leave the matter still in doubt, and show the necessity of Mr Thompson's observations being confirmed before this interesting question can be settled. The insects of the genus *Cyclops* approach so near to some of the *Malacostraca*, however, that were we to reason from analogy alone, we might easily conceive Mr Thompson's discoveries to be partly confirmed—as the changes which they undergo are almost equally wonderful with any of the genera which he has made the subject of his observations.

† Histoire abrégée des Insectes, p. 654.

‡ Mem. pour servir à l'hist. des Insectes, Vol. vii. p. 435.

§ Hist. des Monoc. p. 17.

covering having grown under the old one, when the process of changing it commences, the insect fastens itself to the bottom or side of the vessel in which it is, or to any solid object near it, so as to give itself support. It then, by moving its limbs, and shaking the valves of the shell, the new parts at the same time coming forward, loosens the old covering, and in a short time frees itself from the exuviæ altogether, leaving behind, the sheaths of the limbs, hairs, plumes, and even the minute setulæ that almost escape the power of the microscope itself from their fineness, such as the delicate plumose setæ which adorn the long filaments of the tail. "How, beyond all idea," says Muller, from whom I have taken this description, "this most subtle fineness, for they are sheaths containing other smaller sheaths, which again include other organs smaller still." * The number of times they moult during life is not known, but Jurine says, they ordinarily, though not always, moult before each time of laying eggs. They certainly do not always do so; and perhaps the frequency of their moulting may depend much upon the temperature, the seasons, &c.

Having the experiments of Spallanzani and others, upon the reproduction of mutilated members in various animals, before his eyes, M. Jurine instituted a series of experiments upon the *C. quadricornis*, to see how far this power existed in this genus of insects. In most of his experiments he failed, the insects having died before they moulted, and without showing any evident change in the mutilated members. At length he succeeded. He cut off about two-thirds of an antenna in a female which lived and moulted, reappearing, after moulting, with a beautiful perfect new antenna, the old one of the cast shell not having shown the least indication of a change.†

Some authors have asserted that these insects possess a wonderful power of resisting drought, and that when, by reason of the summer heats, the marshes become dried up, the little creatures do not die, but as soon as the mud becomes moistened by the rain, they recover entirely. Jurine, however, doubts this, and instituted a series of experiments to prove that they have not this faculty. He selected 12 of the *C. quadricornis*, removed them out of the water, and allowed them to remain fifteen minutes dry; 7 of them he found to be irrecoverably dead, the remaining 5 recovered. Again he selected 12 others, and allowed them to remain twenty minutes dry—11 out of the 12 died. A third time he selected 12, and after expos-

* Entomostraca, p. 9. † Hist. des Monoc. p. 40.

ing them in a state of dryness for twenty-five minutes, he found that all had irrecoverably perished.*

Their power of resisting the action of cold, however, according to Muller, is much greater than their power of defying drought. In an experiment which he details, he says, that he exposed some individuals of the *C. quadricornis* in a glass vessel to a freezing air, and that when fully frozen, he continued the exposure for twenty-four hours. At the end of that time he placed the vessel containing their frozen bodies in a warm bath, watching the effect of this upon them frequently during the succeeding twenty-four hours, but without seeing any motion. Next morning, however, upon looking into the vessel, he observed, not without wonder, the insects alive, and swimming about as before congelation, the females with their bags of eggs adhering to them as usual ; † they did not all recover, but the greater part were restored to life. In some other similar experiments upon these insects, especially the *C. castor*, throwing them into a state of asphyxia by means of spirit of wine, and then restoring them to life again, Jurine found that the first part of the body to show irritability and a return of motion was, not the heart, as perhaps might be expected, but the alimentary canal—the heart seems to be next—then the antennæ, and last, the feet.

De Geer asserts that the *Cyclopes*, along with the other Monoculi, are nourished by animalcules. Leeuwenhoek, in addition to this, asserts that when in want of other food they devour their own young. De Geer also says, that he has seen this frequently to be the case. Jurine has repeatedly seen the same, but says, in vindication of his beloved insects, that it would appear from what he has noticed, that they do not do so *from taste*, but that the helpless young cannot resist the action of the whirlpool the mother causes around her, and are thus carried unconsciously into the old one's mouth. I have also frequently noticed the sudden disappearance of the young when no other insects were in the vessel but their mother, and who, it is most probable, must have devoured them, and from what I have noticed, I think the variety *albidus* of the species *quadricornis* is the one which possesses this carnivorous propensity in the greatest degree. Muller, however, maintains that the *C. quadricornis*, as well as others of the Entomostraca, live upon vegetable food ; and I have mentioned in my former paper (page 40) the experiment he instituted upon the sub-

* Hist. des Monoc. p. 39.

† Entomostraca, pp. 5, 6.

ject.* That he is wrong cannot be doubted, I imagine, and there is every reason to presume, that their being carnivorous serves a most useful purpose in the economy of nature. The adults in their turn fall victims to, and are devoured by, other insects, the chief of which are the Hydrachnæ, Hydræ, and larvæ of aquatic insects, which destroy them in such vast numbers, as in some measure to counterbalance the most extraordinary fertility which they possess, and which I have already mentioned above.

Species.

A. *Fresh Water Species.*

1. *Cyclops quadricornis.*—Plate VIII. Fig. 1, 1-14.—*Specific character.*—Antennis longis; corpore ovato; cauda recta bifurcata; furcâ utrâque setis quatuor plumosis instructâ; ovariis externis duobus.

Synonimes, &c.—Cyclops vulgaris, *Desmarest*, Considerat. generales sur les Crustacés, p. 362.

Monoculus quadricornis, *Jurine*, Hist. des Monoc., &c. 1820, pp. 1-49. Plates 1, 2, 3.—*Figures excellent.*

Cyclops quadricornis.—*Ramdohr*, Beyt. zur Naturg. einigen deutschen Monocarten, 1805. Pp. 1-6, t. 1, fig. 1-10; t. 2, f. 1, 3.

Cyclops quadricornis—*Muller*, Entomostraca, &c. p. 109, tab. 18, fig. 1-4, 1785.—*Figure pretty good.*

Nauplius saltatorius, (the young in its first state,) *Muller*, Entomost. p. 40, tab. 1. fig. 3-7.

Eichhorn, Beytrage zur Naturgeschichte dar Kleinsten Wasserthiere, p. 54, tab. 5, fig. *m. n.* 1781.—*Very bad figure.*

Le Monocle à quatre cornes, *De Geer*, Memoires pour servir à l'histoire des insectes, tom. 7, p. 483, plate 29, fig. 11-12, (adult insect,) plate 30, fig. 5-9, (egg and young,) 1778.—*Figures not quite correct.*

Monoculus quadricornis, *Fabricius*, Systema Entomologiæ, p. 295, 1775.

Der Naturforscher, *Stuck* 5, p. 247, 1775.

Neue Mannigfaltigkeiten, i. p. 640, fig. 3, 1774.—*Figure apparently copied from Roesel.*

Le Monocle à queue fourchue, *Geoffroy*, Hist. abrég. des Insectes, Vol. ii. p. 656, No. 3, plate 21, fig. 5, 1764.—*A very bad figure.*

Pediculus aquaticus, *Baker*, Employm. for Microsc. p. 383, pl. 15. fig. 1-4. 1764.*

Monoculus quadricornis, *Scopoli*, Entomologia Carniolica, p. 413-1139, 1763.

Monoculus Apus, *Poda*, Insecta Musei Græcensis, p. 125, tab. 1. fig. 11, 12, 1761.†

* Geoffroy also says, that *all the Monoculi* live upon vegetable matter alone.—Hist. abrég. des Insect. Vol. ii. p. 654.

† Baker's correspondent complains sadly of the figures which Leeuwenhoek gives, as being very incorrect, and yet the figures which he gives are ten times worse than Leeuwenhoek's!!

‡ The name of Mon. Apus is given incorrectly by Poda, as his figure, though very indifferent, is clearly that of the C. quadricornis.

Roesel, der Insecten Belustigung, Tom. iii. p. 606, tab. 98, fig. 1, 2, 4, 1755. *
Monoculus quadricornis, *Linné*, Fauna Suecica, No. 2049, 1746.
Baker, Microscope made easy, p. 93, plate 9, fig. 1, 2, 1743. *Figures copied from Philos. Transact.*
Philosophical Transactions, No. 288, accompanying plate, fig 5, 1703.—*Figure tolerably correct.*
Leeuwenhoek, Epistolæ ad Societatem regiam anglicam, p. 142, fig. 1, 2, 3, 1699.—*Figure incorrect.*
Blancardus (Stephanus) Schou-burg der Rupsen, Wormen, ma'den, &c. p. 151, tab. 13, fig. B. 1688.—*A very bad figure.*
Habitat.—Standing water, every where, all the year round.

Description.—From 7–12ths to 9–12ths of a line long.—Body (Plate VIII. Fig. 1. *a*,) of four segments. Tail (*b*) of six—the latter terminating in two lobes. First ring of body much larger than any of the others, being equal in size to the other three. Second and third nearly equal in size, the fourth being smallest. Antennæ (*c, c,*) of numerous articulations, from seventeen to twenty ; each articulation throws forward a seta, sometimes two. In male, both antennæ (Fig. 2, *a, a,*) possess a peculiar swelling and hinge-joint. Antennules (Fig. 1, *d. d.*) of four articulations, each furnished with several setæ, terminating one having six, of unequal length. Internal mandibles (Fig. 4,) composed of three parts, body (*a,*) neck (*b,*) and "barbillon" (*c.*) Body of an ovoid shape, convex on upper and concave on under surface, in which concavity is lodged its motor muscle. Neck, a sort of petiole turned upon itself, and dilated at extremity, in which are implanted six pretty strong teeth. "Barbillon," composed of one ring and two long filaments. External mandibles (Fig. 5,) situate a little behind the others, convex externally and concave internally, give origin to several filaments and processes, and are terminated by two strong horny teeth. This organ does not exist in the other species. Hands ; (Fig. 6,) each is divided to the base into two parts ; the internal (*a,*) which Jurine compares to a thumb, is much smaller than the other, is formed of three articulations, the two first of which have on inner edge several pretty strong plumose spines or setæ, while the third, which is much the smallest, is terminated by three spines. External division (*b,*) is also composed of three articulations, upon the first of which reposes the thumb ; the second is much longer, and has on

* The figure of the Cyclops is given in this plate by Roesel, chiefly as being the resting-place for a species of polype which he describes, and with which, as often happens, the body of the insect is almost completely covered. Though not *very correct*, it is much superior to the figures given by Eichhorn, Baker, Geoffroy, &c. and really forms with its clusters of polypes a very pretty plate.

internal side, a tubercle from which issues a plumose spine; the third, the smallest, consists of three parts, the middle piece triangular-shaped, divided into two strong spines; the internal, situate at its root, giving origin to a long and strong spine, which, near the middle, gives off another; and the external, which is cleft into two strong spines. These five strong spines are called fingers by Jurine, but, as represented in the accompanying plate, sketched as they occurred to me, they differ very widely in appearance from the fingers represented by him in his figure of these organs; * and though most of the other parts of the insect, as given in his plates, are very correct, I cannot help thinking, however much indebted we may be to the fair artist, that the representation of these parts borrows a good deal from Mademoiselle Jurine's imagination. Feet (Fig. 1, *e*, Fig. 7,) eight in number, or four pairs; each foot is double, or composed of two stalks arising from a common base; each stalk consists of three articulations, and each articulation is furnished with plumose setæ, the terminating one having six or seven. The first pair of feet do not differ from the rest. First ring of tail is very small. In the male (Fig. 13,) the second ring is the largest, while in the female (Fig. 1,) it is the third. The last gives off two long lobes, making the tail appear bifurcated, each lobe giving origin to four plumose setæ, the two intermediate of which (Fig. 1, *f*, *f*,) are much the longest, and have near upper extremity a small joint, which adds much to the suppleness of these fine organs. The fulcra or supports, in this species, are very small. Male organs of generation (Fig. 13, *a*, *a*,) are two oval bodies, situate on each side of second articulation of tail, and terminating in a prolonged point. Internal ovaries (Fig. 14, *a*, *a*,) pretty large and divaricate. External ovaries (Fig. 3,) of same colour as adult, and containing in an old female thirty or forty eggs on each side.

Jurine makes five distinct varieties of this species,† three of which I have frequently seen in this country. 1. *Rubens*, 7-12ths of a line long without the tail filaments; of a reddish colour; external ovaries of same colour as adult animal, (Fig. 14,) 2. *Albidus*, 8-12ths of a line long; of a light-grayish colour; external ovaries nearly at a right angle with tail, (Fig. 3;) body more rounded than in Rubens; male one-third less than female. 3. *Viridis* (Fig. 1,) 9-12ths of a line long; largest of all the varieties; of a green colour, more

* Plate 2, Fig. 6, 7.—The figure of these organs, as given by Ramdohr, tab. ii. fig. 2, of his work, though not altogether correct, is much nearer the truth than that of Jurine.

† "Variat colore albida, fulvescente, viridi et rubro."—Muller, p. 112.

or less deep; external ovaries not so much at a right angle with tail as preceding.

2. *Cyclops Castor.* Plate X. Fig. 1.—*Specific Character.*—Antennis longioribus; cauda bifurcata; furcâ utrâque setis quinque plumosis instructâ; ovario externo unico.

Synonimes, &c.—Dioptomus Castor, *J. O. Westwood,* Lardner's Cabinet Cyclopædia (ined.)

Cyclops Castor, *Desmarest,* Consid. gen. sur les Crustacés, p. 363.

Monoculus Castor, *Jurine,* Hist. des Monoc. pp. 50–73, plates 4, 5, 6. 1820. *Figures beautiful.*

Cyclops lacinulatus, *Ramdohr,* Beyt. zur Naturg. pp. 7–9, tab. ii. fig. 4–12. 1805.

Monoculus Cæruleus.—M. rubens, *Fabricius,* Entom. System. 1792.

Cyclops Cæruleus, *Muller,* p. 102, tab. xv. fig. 1–9.—C. rubens, *Muller,* p. 104, tab. xvi. fig. 1–3.

C. lacinulatus, *Muller,* p. 105, tab. xvi. fig. 4–6. 1785. *Figures tolerable.*

Baker, Microscope made easy, p. 93, pl. 9, fig. 2, 1743.—*Figures copied from the Phil. Trans.*

Philosophical Transactions, No. 288, fig. 6 of accompanying plate. 1703. —*Very bad figure.*

Habitat.—Ponds and slowly-running water, as at Dunglass Pond, Yetholm Loch, &c. &c. in Scotland; New River, London. Not so common as preceding species.

Description.—1½ long. Body of six articulations; first largest. Tail of five; the last sending off two lobes, each of which gives origin to five plumose setæ. Eye large, of a fine ruby colour. Antennæ large and strong, of about twenty-six articulations; each segment furnished with one or more setæ; last one terminated by five unequally long ones. In the male, the right antenna alone has the swelling and hinge-joint which characterize the sex. Antennules (Fig. 2) bifid; two branches of unequal length, arising from a common stalk. The shorter of the two can be carried backwards or forwards at pleasure of animal, and is composed of three articulations, the first of which is short, and inserted into common foot-stalk; the second is furnished on its edge with a dozen of small dentations, from which arise as many hairs; and the third is provided at extremity with three long hairs. * The longer branch is also composed of three articulations; the first articulated with body of animal; the third terminates in several long filaments, which have an articulation in the middle of the length, adding much to their suppleness.† Internal mandibles (Fig. 3) resemble somewhat those of preceding species, but have the "barbillons" much larger and bifid, while the

* This part of the antennule is what Muller calls the *palpi.*

† This portion is what Muller describes under the name of *remi.*

neck terminates by a horny acute point, under which are six small teeth on the same plane. This horny point, Jurine thinks, replaces in some degree the external mandibles, which in this species are wanting; and thus not having an organ by means of which to seize its prey, it uses its antennules for that purpose, putting them into rapid motion, causing a regular whirlpool in the water, which attracts every object into its centre, where is situate the mouth. Behind the mandibles, and a little lower, are two small round bodies, almost transparent, which do not exist in the preceding species. These two bodies, when the animal eats, separate from each other so as to open a passage for the food, which is seen to pass through the opening thus made. Jurine calls these the lips. They are furnished with a barbillon (Fig. 4,) which consists of three parts, internal, middle, and external, all provided with hairs. Hands (Fig. 5,) different from those of *quadricornis*, each divided at their origin into two distinct parts—anterior, smaller of two, may be called the thumb, and is composed of three rings, the anterior edge of which is rough with small eminences, from which spring a number of pretty long hairs directed towards mouth; the posterior part is much larger, and consists of six rings, the two first very large in proportion to the other four.* Feet (Fig. 6) are the same as in *C. quadricornis*. Under the last segment of body in the male, we perceive two stalks, almost cylindrical, both arising from one common base. (Fig. 7.) The right one consists of five segments, and is terminated by a strong hook; the left one has only four rings, and is shorter. These bodies are considered as the sexual organs by Jurine, the shorter of the two stalks containing, he believes, the organ itself.† In same situation, in the female, we find the *fulcra* or "supports" (Fig. 8) which Muller calls "uncinuli," and which are of a very irregular shape; and underneath the first ring of tail is the vulva, through which also the eggs pass into external ovaries. Above the vulva we see a triangular reddish body, which Jurine calls operculum vulvæ. In some specimens of this species, we occasionally see on each side of the tail, two, four, or six elongated bodies, the direction of which is always backwards. In females, they are found adhering round the operculum vulvæ by a long and slender petiole, from which issues a sort of demi-capsule, which Jurine compares to an acorn. From this envelope springs a cylindric transparent body, which shows in its interior a longitudinal opaque line. These are what Muller calls the *laciniæ*, which he regards as some particular organs belonging to the

* These organs, the hands, are what Muller describes under the name of *laminæ radiatæ*.

† These are the "Spicula duo curva" of Muller.

animal, and are sufficient, he considers, to constitute it into a distinct species, named by him *C. lacinulatus*. At first observing them, Jurine says he was disposed to consider them also peculiar organs, and that it was a distinct species. After very attentive observation, however, he found the number to be irregular; and sometimes he found them in males adhering to the base of the posterior feet; he found them to separate spontaneously from the body of the animal, and, in short, discovered them to be nothing less than *animalcules*, the base upon which they were planted being a kind of moss, with which these insects are often covered. Jurine says that it is in the months of March and April that these insects are to be met with; but the only time I ever saw a specimen with these peculiar bodies adhering was in the month of October. It was taken from Yetholm Loch, Roxburghshire; but an accident occurring to the vessel in which they were placed, prevented me from any lengthened observations upon them. I have not met with the C. cæruleus of Muller; but Jurine distinctly asserts, that the three species of Muller, cæruleus, rubens, and lacinulatus, are mere varieties of one species; and which, from the resemblance he fancied he saw in the tail of the female, when loaded with eggs, to that of the beaver, he has named Monoc. Castor. It is a very beautiful species, and is the most elegant of all we know. "Son port," says Jurine, "est élégant; sa maniére de s'élancer dans la liquide est noble et hardie; ses mouvemens sont libres et faciles; tout enfin annonce chez lui une superiorité qui characterize la grandeur de l'éspéce à laquelle il appartient."

3. *Cyclops minutus*, Plate IX. Fig. 1–14. *Specific Character.*—Antennis curtis; corpore lineari; cauda biloba; lobo utroque setis duobus inæqualibus instructo; ovario externo unico.

Synonimes, &c.—Canthocarpus Staphylinus, *J. O. Westwood*, Lardner's Cab. Cycl. (ined.)

Cyclops staphylinus, *Desmarest*, Consid. gen. sur les Crustacés, p. 363.

Monoculus staphylinus, *Jurine*, pp. 74–84, pl. 7, fig. 1–19. 1820.

Cyclops minutus, *Ramdohr*, pp. 10–13, tab. iii., fig. 1–9. 1805.

Monoculus minutus, *Fabricius*, Tom. ii. p. 499, No. 45. 1792?

Cyclops minutus, *Muller*, p. 101, tab. xvii. fig. 1–7.

Amymone (young state,) *Muller*, p. 42, tab. ii. 1785.

Eichhorn, Beytrage zur Naturg. der Kleinsten Wasserthiere, p. 53, tab. v. fig. K, L. 1781. *Very bad figures.*

Do. do. (young state,) p. 41, tab. iii. fig. *p.*

Satyr, *Baker*, Employ. for Micros. (the young state,) p. 314, pl. 12, fig. 23, 25, 26. 1764.

Philosophical Transactions, No. 288, for November and December, 1703.

Habitat.—Pools and ditches. Common all the year round.

Description.—Body and tail not distinctly separated from each other; composed of ten segments, first segment largest, last one, terminating in two short lobes, from which issue two long filaments, slightly serrated on their edges. At the junction of the fifth with the fourth articulation, the body is very moveable, and the animal frequently turns up the posterior extremity upon the anterior, in the manner of the species of beetle called *Staphylinus* (Plate IX. Fig. 1.) Jurine has taken the trivial name of *Staphylinus* from this circumstance, objecting to the name of *minutus* by which Muller designates it, as he says it is possible we may find still smaller species. I have, however, retained the name which Muller gave it, as he is the first author who has given any lengthened description of it. The males are smaller than the females—antennæ, (Fig. 1, 2, *a a*) very short compared with those of preceding species. In female (Fig. 3) composed of nine articulations; in male (Fig. 4.) only of seven. Between fourth and fifth articulation, in both sexes, we see a small lateral ring, of one short articulation and three or four short setæ. In male both antennæ have swelling and hinge-joint, the swelling existing chiefly about the fifth articulation, all the five first, however, being of greater size than the corresponding ones in the female; hinge-joint near the extremity. Antennules* (Fig. 5.) composed of two articulations: upon first articulation is placed a small shoot terminated by four setæ, second articulation furnished with seven short spines on upper edge, and terminated by four longer ones. Jurine makes the antennules consist of six articulations, and his figure of these organs differs entirely from mine, which, after frequent and repeated examinations, never varied in their appearance in the slightest. Mandible (Fig. 6.) in figure resembles very much the internal mandible of the quadricornis, the "barbillon" springing from the centre, and consisting of three articulations, terminated by several setæ. The lips in this species are easily to be seen, and are provided also with a "barbillon," which is a pretty large oval body (Fig. 7.) dividing at extremity into four fingers of equal length, each furnished with three setæ. Hands (Fig. 8.) of more simple organization than in the preceding species. They consist of three articulations, the last of which appears to be a very fine hook, forming with the other two, an angle always directed forwards towards the mouth. These hooks appear to stop all molecules of food in their passage, and by their constant motions carry them to the mandibles. Feet (Fig. 9, 10,) much longer in proportion than in either of the preceding species, and differing in some respects from each other. The

* "Palpi" of Muller.

first pair (Fig. 9,) has both stalks divided into three articulations, the external (*a*) has all three of nearly an equal length, whilst the internal (*b*) has the first articulation nearly as long as all the three of the external together, but the two last are short and inclined outwards. The three other pairs (Fig. 10,) have the internal stalk shorter than the external; both consist of three joints, though Jurine says the external has five: the last pair are the longest of all. The fulcra or supports (Fig. 11,) are situate under fifth segment, and consist each of a broad flat body, from one side of which issues an appendage or kind of finger furnished with several hairs, the opposite side being rounded, and also giving off a number of setæ. In the same place in the male are situate the organs of generation. At the base of sixth ring in female are the openings of the canalis deferens, and under sixth and seventh segments the adults of same sex carry a very singular, horny looking, club-shaped organ, which is fastened to the body by a narrow elongated stalk. It is somewhat curved and directed backwards, its colour almost always more or less red. This organ is not found in the young female, till after she has several times laid eggs. Its hardness is greater than that of the shell of the animal; its use is not known. Jurine has seen two in one female, one red, the other black. In copulation, the male of this species lays hold of the terminating segment of the tail just above the commencement of the long filaments which issue from it, as represented by Muller in his plate of this species.

B. *Marine Species,*

4. *Cyclops chelifer*, Plate IX. Fig. 15–22. *Specific Character.*—Antennis brevibus; capite rostrato; manibus chelatis; cauda biloba; setis duobus longitudine corporis; ovario unico.

Synonimes.—Cyclops chelifer, *Muller*, p. 114. tab. xix. Fig. 1—3.

Cyclops Johnstoni, *Baird*, Transactions of Berwickshire Naturalists' Club, p. 97. plate 2. fig. 4.

Habitat. Sea shore of Berwickshire, as at Cockburnspath, Berwick bay, &c.

Description.—Body of 4, tail of 6, segments—terminating one giving issue to two long, linear, finely serrated setæ, fully the length of the body; upper or cephalo-thoracic segment of body beaked, or having a short conical proboscis in centre. Antennæ (Fig. 16) short, of about 10 articulations in female—at junction of fourth with fifth, is a small lateral ring in both sexes. About fifth ring in male (Fig. 22) is the swelling, which is in the form of a bulla or bladder, followed by the hinge-joint. Antennules (Fig. 17) of two articulations, as in *minutus*; the first having a shoot sent off from about its centre, consisting of two articulations, furnished with several setæ; the

second terminated by five setæ, the three internal being longest, and having a joint near the middle of their length. The mandibles appear to resemble very much those of *minutus*, the teeth, however, being more distinctly seen; and the barbillons of lips are also very like those of preceding species; but, from the rigidity of the parts in the specimens from which my figures were taken, I could not sketch these minute organs properly. Hands (Fig. 18) of three articulations; the first one long; the second short, thick, and curved; the third being a strong curved hook, the two latter together having the appearance of a very strong claw. First pair of feet (Fig. 19) consist of two unequal stalks arising from a common base; superior stalk (*a*) the longer of the two, composed of two nearly equal stalks serrated on upper edge; the second terminating in three short hooks; the inferior stalk (*b*) also of two articulations, the first of which is much the longer of the two, and serrated, the second being very short, and terminating in two curved hooks. The three other pairs of feet (Fig. 15 and 20) consist, each stalk, of three articulations, furnished with long hairs, one or two of the long terminating ones being finely serrate; external stalk (*a*,) as in *minutus*, larger and longer than internal; all three pairs of feet resemble each other. Supports or fulcra (Fig. 21) consist, each, of a broad flat body, rounded at one side, and furnished with several pretty long finely serrated setæ; the opposite side giving off an appendage or finger, also provided with several serrated setæ. This species I have named *chelifer;* but it differs from the figure and description of Muller's *chelifer* in so many points, that in a paper upon the Berwickshire Entomostraca, read before the Berwickshire Naturalists' Club, and since that, published in their Transactions, I made a distinct species of it, and named it *Cyclops Johnstoni*. Upon more minute examination, however, I have again changed its name, restoring to it that of Muller, as it approaches, notwithstanding its discrepancies, sufficiently near that species of his, to be identified with it. In Muller's species, he says there are no articulations to the body, which he describes as "farciminis facie," and there are only three articulations to the antennæ. These characters are so much at variance with the analogous portions of the body in all the other species, that, as he mentions it as a rare species, it is most probable Muller must have made some mistake with regard to them. Some differences also exist in the first pair of feet, and the length of the caudal setæ—but they agree so well in the very characteristic hands, in the beaked head, &c, that I have now no hesitation in referring my species to Muller's *chelifer*.

5. *Cyclops Stromii.*—Plate IX. Fig. 23-25. *Nova species.*—*Specific Character.*—Antennis curtis; capite rostrato; manibus unguiculatis, cauda biloba, setis duobus brevibus instructa; ovario externo unico.

Habitat. Shore at Cockburnspath, Berwick bay, &c.

Description.—Body and tail, as in the others, consist of ten segments, gradually tapering to extremity without any very decided difference between tail and body. First segment the largest, furnished with a conical beak—last segment terminating in two lobes, which give issue to two setæ, much shorter than in the preceding species, being scarcely half the length of the body. Antennæ of about eight articulations; at junction of fifth with sixth, having a lateral ring. In male (Fig. 25) the swelling and hinge-joint are as in preceding species. All the articulations of the antennæ throw forward one or more short setæ. Antennules, as in the preceding species, of two articulations, the second being terminated by about four pretty long setæ. Mandibles were not seen; hands, like those of *C. minutus*, consist of two articulations, and a pretty strong hook, which points upwards. First or thoracic pair of feet have the external or superior stalk much smaller and shorter than the other, and is divided into three joints, the last of which is terminated by three pretty strong setæ or small hooks. The internal or inferior is much the longer of the two, and consists of two articulations, the first being very long in proportion to the second, which is exceedingly short and terminated by a curved hook. The abdominal feet are exactly the same as in last species—and the fulcra or supports which I could not examine accurately, seemed to be also similar to those of the *chelifer*. I have named this species after Ström, who has given a description of a species of Cyclops in the Acta Hafniæ, 9th vol. which has some resemblance to this, as translated by Muller in his Entomostraca, under the name of *C. brevicornis.* *

6. *Cyclops furcatus.* Plate IX. Fig. 26-28. *Nova species.*—*Specific Cha-*

* In the edition of the Acta Hafniæ in the British Museum, the figures which Ström gives of the *brevicornis* are unfortunately awanting. In Muller's description of the *brevicornis*, which he professes to take from Ström, he says the tail setæ are very short, "setis caudæ brevissimis," while Ström in his description says they are very long, "setis caudæ binis longissimis"! In my paper in the Transactions of the Berwickshire Naturalists' Club, I have quoted the species described above as the *C. brevicornis*, taking the description as given by Muller, not having at that time seen the Acta Hafniæ—and not being aware of the discrepancy which exists between the two descriptions. Vide Ström's paper in "Det Kiobenhavnske Selskabs skrivter," 9th vol. p. 590, 1765.

racter.—Antennis furcatis; capite brevi-rostrato; manibus unguiculatis; ovario externo unico, magno.

Habitat.—Berwick bay.

Description.—Body and tail distinctly separate from each other, of ten segments, the first the largest, the last terminating in two short lobes from which issue two long setæ, more than half the length of the body, and two others about half the length of the former. First segment furnished with a short beak. Antennæ very distinctly forked, consisting of about seven or eight articulations. Fork taking place at fourth articulation—upper limb not articulated, longer than lower limb, which is divided into three or four articulations. Each articulation throws upwards and forwards a tuft of short setæ. Antennules of two joints, the latter terminating in three or four pretty long setæ. Mandibles were not seen. Hands of two articulations and a curved hook pointing upwards, as in *minutus*. Thoracic or first pair of feet (Fig. 28) have the superior or external stalk the longer of the two, of two joints, first short, second longer, having a strong tooth or process on inferior edge, and terminating in three or four short curved setæ or hooks. Inferior or internal stalk of three articulations; first short and thick; second longer and broad; third short and terminated by two pretty long straight setæ or hooks, and five or six curved ones, each gradually becoming shorter than the others. Abdominal legs as in the other species above-mentioned. Fulcra or supports have the appendage or finger in the form of a long, slender, slightly curved stalk, toothed or serrated on the upper edge, and terminating in three or four hairs. The external ovary is single, large, and generally lying across the tail, in consequence of which perhaps the insect generally swims prone or supine, seldom swimming on lateral surface, as most of the other species do. I have only met with three or four specimens of this species, all females; and in two or three of these, there was attached to the dorsal surface of the fourth segment of the body, a substance very much resembling a polype (Fig. 26,) consisting of a pedicle and three branches, each branch terminated by four short fingers.

7. *Cyclops depressus.* Plate X. fig. 9–12.—*Nova species.*—*Specific Character.* Corpore lati-depresso; antennis brevibus; cauda biloba, setis duobus brevissimis instructa.

Habitat. Berwick bay.

Description.—Body depressed, flat and broad, differing in this respect very much from all the other species described; of four segments, the first of which is much the largest, being more than equal to the three succeeding ones, and having the upper part projecting

in a short obtuse point; tail about one-third the length of the body, terminating in two very small lobes, from which issue two very short setæ. Eye situated rather lower down than usual in the other species, of a fine ruby colour. Antennæ short, strong, subcylindrical, setiferous, of about six articulations; in the female having a lateral ring at junction of fourth and fifth; swelling in the male, (Fig. 10) situate in the fourth, followed by the usual hinge-joint, and terminating in a hook. Antennules of two articulations, the latter being terminated by about four short setæ. From opaqueness of body and flat form, I could not distinctly perceive the mandibles or hands, except that the latter were terminated by a curved hook as in *minutus*, *&c.* Thoracic pair of feet consist of two stalks as usual, rising from one common base, each stalk consisting of three distinct joints, (Fig. 11.) Superior or external stalk longer than inferior one, the last joint terminating in four short hooks. Inferior stalk terminated by several short setæ, and having a long seta given off at each joint. Abdominal legs, of the same form and structure as in the other species, and provided with numerous long hairs or setæ. Sexual organ of male? (Fig. 12,) very large, consisting of a broad plate issuing from junction of first with second segment of tail, terminating in a pretty long, bluntish, hollow spine, and having four short teeth or hollow spines on outer edge; the whole organ being nearly of an equal length with the tail. In the female the fulcra or supports issue from same place, and so nearly resemble the male organ as to make them appear the same. They are not so broad, however, and have only two lateral teeth, both of which are situate near the base. In the female the second segment of tail is much larger than in male.

The posterior two-thirds of thoracic segment is marked with a broad fascia of a very dark colour, with a ruby tinge in it. Two upper segments of tail are marked in the same manner, but not of so deep a colour. I have met with but few specimens of this very pretty species, and never with a female with ova.

The motion of this insect is peculiar. It generally swims on its back, and instead of darting *forward* through the water, as the other species of Cyclops do, it springs with a bound from the bottom of the vessel where it rests when undisturbed, *up to the surface* of the water. For this purpose it curls its body up into the form of a ball, and then suddenly returning to the straight position, springs with a sudden bound from the bottom to the surface, falling gradually down again to the same place from which it sprung.

I have noticed one or two other marine species of *Cyclops* on the

coast of Berwickshire, but not having correct sketches of them, I shall not take notice of them here.

(To be continued.)

Explanation of Plates.—Plate VIII. Fig. 1, female of *C. quadricornis*, var. *viridis*, lateral view, (*a*) body; (*b*) tail; (*c, c*) antennæ; (*d, d*) antennules; (*e, e*) feet; (*f, f*) plumose setæ of tail; Fig. 2 (*a, a*) antennæ of male, to shew the peculiar swelling and hinge-joint; Fig. 3, tail of var. *albidus*, to shew the external ovaries; Fig. 4, internal mandible, (*a*) body; (*b*) neck; (*c*) "barbillon;" Fig. 5, external mandible; Fig. 6, hand; (*a*) internal portion, or thumb; (*b*) external do; Fig. 7, feet, first pair; Fig. 8, ovum at maturity; Fig. 9, young, a few hours after birth; Fig. 10, young, eight days old; Fig. 11, young, fifteen days old; Fig. 12, young after first moulting; Fig. 13, tail of male, to shew organs of generation; Fig. 14, female of var. *rubens*, to shew internal ovaries.

Plate IX. Fig. 1, female of *C. minutus*; (*a, a*) antennæ; Fig. 2, male of do; (*a, a*) antennæ; Fig. 3, antennæ of female; Fig. 4, do of male; Fig. 5, antennule; Fig. 6, mandible; Fig. 7, "barbillon" of lips; Fig. 8, hand; Fig. 9. thoracic or first pair of feet; (*a*) external stalk; (*b*) internal do; Fig. 10, second pair of feet; Fig. 11, fulcrum or support; Fig. 12, young just born; Fig. 13, young, eight days old (in October); Fig. 14, do. fifteen days old (October) Fig. 15, female of *C. chelifer*; Fig. 16, antennæ of female; Fig. 17, antennule; Fig. 18, hand; Fig. 19, thoracic or first pair of feet; Fig. 20, second pair of feet; Fig. 21, fulcrum or support; Fig. 22, male antenna; Fig. 23, female of *C. Stromii*; Fig. 24, first pair of feet; Fig. 25, antenna of male; Fig. 26, female of *C. furcatus*, in supine position, shewing external ovary and polype like body; Fig. 27, do. lateral view to shew its various members; Fig. 28, first pair of feet.

Plate X. Fig. 1, *C. castor*; Fig. 2, antennules; Fig. 3, internal mandible; Fig. 4, barbillon of lips; Fig. 5, hand; Fig. 6, feet, first pair; Fig. 7, male organs; Fig. 8, fulcra or supports; Fig. 9, female of *C. depressus*; Fig. 10, male of do; Fig. 11, thoracic or first pair of feet; Fig. 12, male sexual organ.

II.—*Observations on the Germination of Ferns.* By Mr J. Henderson. Plates XI. XII.

The first account of the germination and raising of ferns from sporules was given by Mr Lindsay, in a paper read before the Linnæan Society, January 3d, 1792, and published in 1794 in Linn. Trans.

Vol. ii, p. 93. As far as it goes it is tolerably correct, but the figures are very rude and incomplete, and the process of germination is not progressively followed up to the developement of the first gyrate frond, when the young plant first assumes the peculiar habit of its order.

In 1819 a letter from Sir James Smith was read before the Horticultural Society of London, describing a method of raising ferns from seed (as it is termed) practised by Mr Henry Shepherd of Liverpool, and the principle then recommended by him has been found so successful, that if good seed* can be obtained, a crop of seedling ferns are raised with as much certainty, as one of any other plants.

In 1824, a paper on the germination of ferns by the Rev. John Macvicar of Dundee, was read before the Royal Society of Edinburgh, and published in the 10th vol. of the Transactions in 1826. A more minute account of the developement of the sporule, and more correct figures are given, but the investigation stops at the same point as that to which Mr Lindsay carried his observations.

Figures are given also by Agardh† in his Lehrbuch der Botanik, t. 3 f, 40–42; and the mode of developement of the first gyrate frond, which is incorrectly represented by Mr Lindsay and Mr Macvicar, is roughly, but accurately, delineated. Indeed the analogy between the young fern at that particular point of its growth, and a germinating endogenous plant appears to be now well known.

I have not, however, at present seen any thing like complete and satisfactory figures of these plants during every stage of germination, and as the subject appears to be one likely to lead to very important inferences‡ with regard to the intimate structure, as well of the more highly organized plants, as of those which are merely cellular, the present observations, which have not however, any pretensions to novelty, except the existence of an integument§ in the sporule be a new fact, will not, I trust, be deemed superfluous.

* The word seed is here used in a practical sense only. The notion of Agardh, that the organ commonly called the capsule with its ring, is a seed with a prominent raphe, containing many embryos, is perfectly untenable.

† I have to acknowledge the assistance of a friend in pointing out this, and some other references to which I could not otherwise have had access.

‡ The developement of the fronds in full-grown ferns appears to me highly worthy of consideration. In Asplenium nidus, Aspidium fraxinifolium, Adiantum reniforme, &c. the younger portion of the frond is nearly transparent, and affords an opportunity of examining the manner in which the parenchyma is formed.

§ If I mistake not there is an integument of a very peculiar structure in the sporules of Equisetaceæ. If this be found to be the case generally with sporules, the analogy between them and pollen grains will be very striking, and the supposition, that they are mere modifications of the cellules, greatly strengthened.

Before describing the process of germination minutely, it may be as well to give a few practical directions, the result of some attention to the culture of ferns, for the guidance of any one who may feel inclined to verify these observations.

In the early stage of vegetation ferns are so exceedingly delicate in structure, and so liable, from the simple nature of their organization, to be affected by atmospheric changes, that it has been found necessary, even in a hot-house, in order to preserve a uniformly moist atmosphere, to keep the seed-pots under hand-glasses, until the seedlings have acquired strength enough to bear exposure without injury: by this simple contrivance, plants which could not be propagated by any other means are now increased to any extent.

The sporules will vegetate on almost any kind of soil when treated in this way: I have had them vegetate on the surface of a piece of glass made to fit on the stage of a microscope, for the purpose of observation, and this is by far the best method of observing them in the act of germination. But if the object is to continue the observations until a gyrate frond is developed, attention must be paid to the nature of the soil on which the seed is to be sown.

Perhaps the best soil to use would be a mixture of peat (in which there is a natural admixture of sharp sand) and a small quantity of loam; and if this cannot be procured, such a mixture as the following will be found to answer very well, namely, three parts of peat, two of sand, one of loam, and one of finely pounded potsherds, the whole mixed and passed through a fine sieve.

About a third of the pot in which it is intended to sow the seeds should be filled with potsherds for draining, and the rest, to within a quarter of an inch of the brim, is filled with the mould, pressed down a little, and watered several times with a very fine rose, until the surface is perfectly smooth, and the soil saturated with water.

The seed is then sown, and the pot placed under a hand-glass. Some cultivators place the seed-pots in pans filled with water, but where the soil is apt to generate minute algæ, such a practice is better avoided. I prefer having a hand-glass large enough entirely to cover the pot, under which there is a uniformly moist atmosphere, and the soil not being so thoroughly soaked with wet, is much less subject to be overspread with Conferva vaginata, Palmellæ, &c. which are so destructive to the seedling ferns. If the glass is kept close, which it should be for a time, very little water will be required, but when it becomes necessary, it should be given from a pot with a very fine rose, (the holes of which should not be larger than just to admit the point of a very small pin) with great care, and

this should be repeated whenever the surface of the pot begins to get dry, particular care being taken to sprinkle the water evenly, and not to inundate the pot: a little should be given at a time, allowing it to be absorbed by the soil before it is repeated, and if possible it would be better to use only rain water.

In sowing the seed, if it has been recently gathered, it will be necessary to avoid sowing too much, a very small quantity will suffice to sow a pot, merely a thin dusting spread regularly over the surface. As the seed is extremely minute, the error of sowing too much is more easily committed than avoided, but it should be guarded against, as the seedlings are more likely to succeed if only a moderate crop, than when thickly crowded; the seeds of ferns, however, like the seeds of other plants, are apt to lose their vegetating qualities with age, and if the seed has been gathered a year or two, it will be necessary to sow it thicker.

Due attention must be paid to the state of moisture on the surface of the mould, after the seeds are sown, to guard against such an excess of it as will cause mould or any minute algæ to grow, keeping just such a state of humidity as will supply the absorbent wants of the seedlings.

As soon as the lobes of the seedlings begin to widen and assume a determinate shape, the hand-glass may be tilted up, and a little air admitted, and this may be increased from time to time until the plants can bear exposure; if they are too much crowded, they may be successfully thinned out, and the thinnings transferred to another pot: and it must be observed that the glasses should he shaded during very bright sunny weather, or placed under the shade of other plants.

These directions will sufficiently enable any one to repeat the observations on the germination and primary vegetation of ferns to which the following remarks refer. The sporules of the different sorts of ferns vary much in the time they take to germinate after they have been committed to the earth; some will appear in eight or ten days, while others will not be discernible in less than a month. In consequence of their extreme minuteness it will require a high magnifying power to enable any one to observe them during that process.

The first trace of germination is indicated by the appearance of a number of exceedingly minute green specks on the surface of the mould; if one of these is placed under a microscope it will be found that the sporule has burst open into two nearly equal halves, and a small greenish body occupies the lacerated orifice. This is, as far

as I can ascertain, a single cellule, the inert body which was contained in the sporule called into life. The sporule is therefore composed of two parts, namely, the external integument and the internal cellule. The latter swelling beyond the capacity of the former bursts it open, and is then elongated a little beyond the ruptured edges of the integument. From the anterior apex of this primordial cellule, another is emitted generally of a spheroidal form, and about the same time an exceedingly minute pellucid fibril is emitted from its posterior end.

The first indication of the formation of a new cellule is the emission of a small ovate body from the anterior end of the previously formed one: at first it is almost colourless, and appears like a mere exudation of sap; as it advances, its almost liquid surface is gradually changed into a greenish pellicle, and the cellule then swells into a spheroidal form; but this form is very soon altered, when in its turn it has protruded a new cellule. This last, originating on the convex apex of the preceding, (from which it appears to draw the liquid necessary to its own formation) is during its enlargement gradually drawn closer and closer to the other, the convex end of which finally becomes concave as the two surfaces approximate and form the partition between one cellule and another.

The manner in which the cellules increase varies in different species. In some a single cellule is emitted from the primordial one, and from the end of that another, and so on to the amount of four or five before any lateral increase takes place. They then begin to increase rapidly to the right and left, ultimately forming two roundish lobes, with a deep intermediate sinus. As the cellules are added, delicate fibrils issue here and there from their lower surfaces, at or near their union with one another, taking a downward direction, and finally insinuating themselves into the pores of the soil. The lobes continue to increase externally until they have attained a certain size, when all external increase ceases; the primary frond* is then composed of a single lamina of cellules, which diminish in size from the centre to the circumference, and in appearance very much resembles the thallus or lobed frond of some Hepaticæ.

But this is only one of the forms which the primary frond assumes. Some increase more rapidly at first, and soon acquire a circular or reniform shape, increasing by the addition of cellules at the circumference; others divide into a number of lobes, standing nearly upright; while some produce one lobe after another, the lobes being re-

* This term is used because I can find no one given by botanists applicable to this state in ferns.

cumbent, one lapping over the other. Some again have both surfaces covered with minute pedicellate glands, while in others the glands are only found on one side of the frond, and some, as the different species of Adiantum, are perfectly smooth and naked.

When the lobes have attained a certain size, external increase ceases. A slight swelling may sometimes be perceived of the cellules lying at the bottom of the sinus, and between the bases of the two lobes, which are of a large size; from the lower surface of the space composed of these cellules, a number of small fibrils are sent out, which penetrate a short distance into the soil, and supply the whole cellular body with nourishment. They are most numerous under what may be termed the base of the primary frond, namely, where the lamina first begins to widen; and between this and the bottom of the sinus, is the space on which the little knot of cellular matter is elaborated, in which the first gyrate frond and the radicle originate.

The process by which this is produced consists, in the first instance, in the emission from the lower surface of the above-mentioned cellulês of a number of others; generally much larger in size, of an hemispherical form, and proceeding at right angles to the plane of the cellules on which they originate. These arise very near to one another, and soon unite into a confluent mass, forming a thick coating on the surface of the other cellules. From this coating others are protruded, which in like manner become confluent, and this cellular mass, tapering as it accumulates, terminates in a blunt or rounded point.

Previous to the developement of the frond and radicle, a farther accumulation takes place at the summit of the cellular knot, which now begins to swell out at two opposite points. The form of the knots varies in different species. In some it is round or hemispherical; in others nearly flat, and even hollow, in which case the cellular swelling is on the upper surface (sometimes but very rarely the knot itself is produced on the upper surface;) some again are surrounded by short detached filamentous processes, originating on their surface, and composed of elongated almost colourless cellules. These are the incipient paleæ or scales which surround the caudex of some ferns in a more advanced state; in some species, indeed, they assume the characters of flat tapering incurvate membranous paleæ even before the gyrate frond is developed.

There is a remarkable similarity in the appearance of the cellular knot at this stage of its growth, to the formation of the gemmæ or buds produced in the axillæ of the leaflets, and on the surface and the margin of the fronds of some ferns, such as Polypodium pro-

liferum, Asplenium viviparum, &c. In the latter case, however, several fronds are developed before any root appears, but in the former the first gyrate frond is almost uniformly preceded by a root.

The production of the important body above alluded to, is the ultimate end and effort of the primary frond, and as it is the point at which gyrate developement commences, it may be regarded in the light of an incipient caudex. When it is matured, according to some one of the various forms which it assumes in different species, a root is protruded from one side of it, and soon after a small gyrate frond emerges from its summit, which when developed occupies the edge of the cellular knot, having the base of its stipe placed directly over the base of the radicle. This last immediately descends into the earth, while the former rising from under the primary frond opens out into a small simple or lobed leaflet. When this is matured, another is sent out, and the same process is repeated, a new root being in general added with each successive frond. The cellular mass in the meantime accumulates, and is gradually converted into a central caudex. The primary frond having completed its office withers and decays, while the characters of the perfect fern become more and more apparent, as one frond succeeds to another.

I have now traced the progress of this primary state of vegetation from its origin to the point where it passes into the mature plant, and in the magnified representations, some assistance will be given towards forming an idea of the actual appearance which it assumes at different periods.

It will be evident from what has been said, that the reproductive organs here have no affinity whatever with those existing in Phænogamous plants. There is here no seed in the proper sense of the word, no cotyledon, and no embryo.

The likeness which exists between the germination of ferns and endogenous plants is one merely of analogy, for there is no real resemblance in their mode of reproduction. In the one case the embryo is already formed within the seed ; in the other, as it should appear, a single cellule with a proper integument gives origin, cell by cell, to an expansion of cellular tissue bearing no resemblance to the perfect plant, which at length produces from a knot at a particular point, a frond and root bearing a strong resemblance to an endogenous plant when germinating. The real relation then of the germination to what takes place in endogenous plants appears to be, not to the germination of the seed, but to the propagation from the *edges or disc*, of the leaves from the cellular tissue, as in Baryophyllum calycinum, Malaxis paludosa, and a species of Ornithogalum observed

by Turpin. And the inference is perfectly convincing that in ferns (and the mode of reproduction is the same in mosses and Equiseta) there is no impregnation; and if this be true of the plants just mentioned, the argument will be so much the stronger as regards the lower cellular plants.

List of References, Plates XI. XII.

1. Nephrodium marginale 10 days after sowing; *b*, *b*, more highly magnified, shewing the separation of the integument into two halves; *c*, *c*, *c*, Gymnogramma rufa 19 days after sowing.
2. Nephrodium marginale after 16 days, *b* the same much magnified.
3. ——————— 22 days, *b* much magnified.
4. ——————— 4 weeks and 3 days.
5. ——————— 6 weeks and 2 days.
6. ——————— 2 months.
7. ——————— 5 months.

4, 5, 6, and 7 are magnified considerably: the latter has attained its full size, and is on the point of producing the first gyrate frond. In all cases, the first formed cellules either decay or are drawn under the earth by the fibrils, before the primary frond arrives at the state of No. 7.

8. A portion of a lobe of Gymnogramma chrysophylla highly magnified, exhibiting the manner in which the cellules are connected.
9. Lower surface of part of a primary frond considerably magnified, with the large cellules which form the basis of the cellular knot.
10, 11. Asplenium monanthemum, lower surface, showing the position of the cellular knot.
12. A reniform primary-frond of an unnamed fern.
13. Pteris nemoralis with the radicle protruded, and the first gyrate frond partly developed.
14. A portion of the primary frond of Pteris nemoralis, more highly magnified, the lobes folded back, showing the position of the gyrate frond and root on the cellular knot, and its attachment to the primary frond.
15. Aspidium fraxinifolium, the first gyrate frond fully developed.
16. Gymnogramma tartarea, the first gyrate frond a palmate or lobed leaflet, the second arising from its base.
17. Asplenium monanthemum, the first gyrate frond a simple leaflet, the second partly developed, lobed at the apex.
18, 19, 20. Portions of the primary-fronds of three species of ferns, exhibiting the progress of the cellular knot.

21. Gymnogramma chrysophylla,
22. Nephrodium molle,
23. Adiantum cuneatum,
24. Gymnogramma tartarea,
25. Pteris serrulata.

} natural size.

III.—*Observations on the process of Exuviation in the Common Crab* (*Cancer pagurus*, Linn.) By Jonathan Couch, F. L. S.

In a former paper, inserted in the Magazine of Zoology and Botany for August, (p. 170,) it is shewn that the manner in which the lobster disengages itself from its shell is different from that of the prawn and river crayfish. I will now proceed to describe so much as I have been able to observe, of the manner in which the same natural process is effected in the common crab, Cancer pagurus, Linn. and Leach; and which will be found to differ from what has been witnessed in any of the (Brachiouri) long-tailed species, thus rendering it probable that great diversity may exist in the remaining families of the great order of Crustaceans; in none of which have any of the particulars been hitherto observed.

It is necessary, however, to premise, that I do not know how much of novelty my account may be found to possess; the only work on the subject that is within my reach being Dr M. Edwards's recent and hitherto unfinished History of the Crustaceans, already referred to. This author makes a slight reference to some papers by Mr Collinson, in the Philosophical Transactions, on the exuviation of the common crab; but, being unprovided with these works, I can only conclude concerning them, that they do not contain anything to supersede my remarks, since otherwise this learned naturalist would not have failed to have extracted their substance; and I am confirmed in this opinion by the fact, that in some late works on physiology, of deservedly high reputation, what is given on this subject is meagre and inaccurate.

When about to throw off its exuviæ the crab commonly retires to some secret place, in the near neighbourhood of rocks that will afford it shelter when unable to escape from danger, or defend itself from enemies. Its craving appetite seems also at this time to be suspended; but the particular subject of my observation differed from others, in wandering into a crab-pot at this period, in search of food; and being known by the fishermen to be what is called *peel*, that is, about to throw off its crust, it was transferred to the safe custody of the store-pot, on Saturday, July 30th, where, on the morning of August 1, it was found just then delivered from its covering.

As quickly as possible, and without injury, the living crab and its empty representative were brought to me: and the following is a description of the exuviæ.

The longest diameter of the carapace was $6\frac{3}{4}$ inches; compass of the largest chela, and length of the flap or tail, severally $3\frac{3}{4}$ inches: the individual a female, or what is termed by fishermen a Bon Crab. The carapace was sound, except on its under surface, where in its ordinary state a curved line passes backward from the jaws to the hinder part of the body. When caught on the 30th this portion was observed by the fisherman to be loosened; and now the portion included between this waved line and the sternal plate, was entirely separate and fallen inward. The sheaths of the antennæ and palpi perfect; one eye gone, the other remaining, with the transparent covering perfect, the stalk loosely attached; the tail and all its appendages perfect; the sternal plate beginning to break across in the middle, leaving to each portion a pair of legs on each side; but this not being a complete or natural separation, may have been produced by the weight of the limbs alone, or the efforts of the animal. The chelæ and legs perfect in all their attachments, the membranes unbroken; and the flat bones which occupy the middle of the muscles and serve them for tendons or points of attachment for motion, were uninjured and fastened to each joint, their distant extremities hanging loosely in the cavity of the case of the limb. The coverings of the branchiæ were perfect to their minutest extremities; and beside the internal coat of the stomach, the whole internal skeleton of the animal was thrown off without fracture or displacement:—including the two motive bones or levers that pass through the middle of the body from the jaws, to be attached to the internal dorsal aspect of the carapace: where formerly attached, however, to the carapace they hung loose. The curious bony articulations of the grinding apparatus of the stomach, which renders the digestion of these Crustaceans analogous to the rumination of quadrupeds, together with the double crustaceous body (perhaps gland) at the pyloric orifice, and the whole of the bony crusts or chambers that receive the muscles which move the legs, were disengaged without displacement.

The living representative of this wonderful skeleton measured $7\frac{1}{2}$ inches in its longest diameter, the compass of the largest chela, and length of the flap or tail, 4 inches; the weight $24\frac{1}{2}$ ounces, being $5\frac{1}{2}$ ounces less than an ordinary crab of the same dimensions, weighed with it for comparison. It was plump, having much the appearance of a lump of dough enclosed in a membrane; and it was also equally soft, with scarcely more power of motion; appearing sensitive only when pressed on the under surface of the carapace. The

colour above was red, beneath a pale yellow, the flap purplish ; the bristles on the legs fully formed, but soft, which is the more worthy of notice, as I have seen the Porcellana platycheles, in which villosity forms a conspicuous character, entirely naked when just escaped from the crust. On cutting open the legs and chelæ, the bony plates to which the muscles are attached, and which serve for tendons, were found as soft as wet parchment, and towards the extreme joints, could not be distinguished with certainty. On breaking off the largest chela at the joint where the animal is itself accustomed to separate it when injured, the usual membrane formed towards the body, and no discharge took place ; but a watery fluid proceeded copiously from the surface towards the limb, which was thus soon left empty, speedily becoming capable of being blown up with air like a bladder. On proceeding to dissect the body a similar circumstance took place, the fluid running off in so large a quantity, that I regretted when too late, that I had not taken the precaution to have measured it. In a few minutes, the body had so sunk into one mass that I was unable to distinguish the separate parts. At the lower and inner part of each joint of the chelæ and legs, an opening remained, in the form of a slit ; through which the flat central bony plate, found in the empty crust, had been withdrawn ; which opening of course must be closed when the shell is finally consolidated.

It appears from close inspection, that the exuviæ of a lobster consists of the same parts as those of a crab ; the whole internal skeleton and external surface of the branchiæ, with the osseous tendons of the muscles, having been rejected. But they are more distinctly ascertained in the latter species, from their greater firmness of texture ; and I may add also in reference to myself, that a desire to preserve the specimen perfect, had in the former case prevented a very minute examination of the internal structure.

Having procured a crab that was beginning to show signs of a commencement of the process of exuviation, I found the limbs shrunk to three-fourths of what the shell could well contain ; the soft contents of the points of the chelæ being diminished much more than the muscular structure. A greater diminution than this, however, takes place before the process of deliverance is accomplished ; but all the vigilance that I have exerted has not enabled me to see the actual escape from the crust ; which is usually left in some void place, often in a sandy basin, and, as several fishermen have informed me, always on its back ; as the living specimen I have described is represented also to have been found in the store-pot.

The newly extricated crab has at first strength enough to crawl

off to a place of safety, commonly beneath the shelter of a neighbouring crevice, of such limited dimensions at its entrance, that it seems surprizing it should ever be able to return from it, in its new state of growth. The first instinct of nature after securing a place of retreat, is to absorb, I suppose by swallowing it, as much fluid as will distend its organs and their common covering, now as flexible as velvet, to the full extent of their capacity; by which means the deposition of crustaceous particles is made according to the dimensions of its newly acquired bulk: which in the instance now described, that had arrived at the ordinary size of a female, and allowing for the thickness of the first crust, exceeded the former by at least an inch in its longest diameter, and in all its dimensions in the same proportion. In the early stages of growth, the increase of bulk at exuviation is, of course, much more considerable, in relative proportion. Some of these smaller specimens may be found passing through this natural process in every month of the year; but in some adult individuals, the same crust must continue for a long time, since I have seen one with oysters measuring two inches and a half in length, on the carapace; and in another, a muscle (mytilus) about an inch in length, attached by its byssus to a joint near the body.

Whether, as has been said, the rejected case forms a meal for its old inhabitant, on its first return to habits of activity, may well be questioned; though I have known an instance where one crab has devoured another, leaving nothing but the points of the legs, and a small portion of the carapace;—but in the analogous instance of a prawn, that had just thrown off its exuviæ, I have detected the source of the firmness of the new covering, in the presence of small shell-fish in its stomach. Under a lens, a minute trochus, perhaps the T. zizyphinus, and some specimens of an oval bivalve, were distinguishable. This is perhaps the only period of their lives when their food is of this kind, but its nature cannot often be ascertained, by the comminution it undergoes from the manner in which it is devoured, when the jaws have attained their firmness.

Polperro, 1836.

IV.—*Contributions to the Ichthyology of the Firth of Forth.* By Richard Parnell, M. D.

No. II.—*The Tadpole Fish.*

The object of this paper is to shew, that the Raniceps trifurcatus is by no means so rare a fish as naturalists in this country have supposed, and to point out some very important characters in it, which have escaped their attention.

That it is far from being a great rarity I appeal to the authority of Sir Thomas Brisbane, who affirms that he has often met with it on the west coast of Scotland, inhabiting small pools in company with the Pholis lævis and other kinds of blenny; to that of Dr Johnston, who has noticed its occurrence in Berwick Bay; to that of Mr Couch, as well as that of Mr Jago, as to its existence on the coast of Cornwall; to the frequent discovery of it in the Solway by the fishermen; (I myself found it once;) and to the fact of three specimens having been captured by myself in the Firth of Forth; besides Mr Handcock's discovery of it on the Northumberland coast, in May last. Perhaps the investigation of such species, the authenticity of which has been doubted, may be as profitable as the search after new ones, and may save much trouble and confusion to compilers in future.

In appearance this animal little resembles any of our British fishes as to shape or colour, and may well be compared, from its form, to a frog in the tadpole state, from which circumstance it appears to have derived the name of "tadpole fish."

At the origin of the lateral line are nine or ten small tubercles, which are not perceptible when the fish is recently taken; but when the skin is somewhat shrunk by exposure to the sun or open air, these gland-like bodies become very evident.

This appearance caused Dr Fleming to suppose that the Barbus minor of Jago was distinct from Pennant's trifurcated hake, and he described it in his work on British Animals as a new species, under the name of Raniceps Jago. Dr Fleming was unfortunately misled, probably owing to his never having seen the fish, nor perhaps was there then in Scotland a preserved specimen in existence to consult. This defect I have endeavoured to supply by presenting a perfect individual to the museum of the Royal Society of Edinburgh.

This affords an opportunity of observing how liable we are to be deceived when we do not examine specimens in a recent state, and how ready our zeal for discovering new objects is to hurry us into creating species out of imperfect descriptions.

It was not till after careful examination that I came to understand what these elevations on the origin of the lateral line were owing to. At first I imagined they were caused by the elevation of the scales, but by the assistance of a glass I observed these tubercles were not merely placed on the skin, but that they originated beneath the cuticle; while they appear to be small glands for secreting a thick mucus, with which the whole surface of the fish is covered.

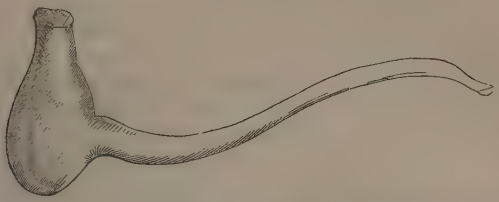
The colour of the body is a dark sooty black; that of the lips, angle of the mouth, and under the gill-covers, of a pure white. The second dorsal, caudal, and anal fins, are of a deep black, with the up-

per margin of the two former shaded with white. The head is large and wide, a little more than one-third the length of the body, with the crown of it remarkably flattened and depressed; the anterior part of the body is round and tumid, while the hinder part is much compressed. On each jaw are a number of small sharp teeth, with a few long ones projecting beyond the rest, particularly on the lower jaw, and on the front of the upper; the anterior part of the roof of the mouth is also furnished with teeth set close together, and arranged in a lateral direction. At the commencement of the œsophagus are four cartilaginous prominences covered with a number of very small sharp teeth, rendering each rough to the touch. The tongue is broad, smooth, and destitute of teeth. The under jaw is the shorter, and furnished with a small conical barbule, placed on its anterior and under surface, which is scarcely perceptible except when the fish is in a recent state. Each eye is situated a little in advance of the angle of the mouth, and is of a pale yellow colour. Immediately over the base of the pectorals, the first dorsal fin commences, which is very small and easily overlooked, composed of three rays, of which the middle is the longest, being about half the length of the pectoral rays. The second dorsal fin commences in a vertical line over the middle of the pectorals, and runs down the back to within a very short distance of the tail. The anal fin begins in a line under the termination of the pectoral rays, and ends at a point not quite so far as that at which the dorsal terminates. The ventral fins arise under the throat, and the two first rays, which are the longest, and of a bluish-white colour, extend a little beyond the origin of the anal fin. The remainder of the rays are about one-third of the length of the two former, and of a dull black appearance. The caudal and pectoral fins are nearly of equal size and form, slightly rounded at the extremity; the latter is of a sooty black colour, with a broad light-coloured band running across the middle. The scales, which are small and very adherent, are scarcely perceptible when fresh. The air-bladder is large, with the coats thick and strong. The numbers of the fin-rays are,

1st D. 3; 2d D. 67; C. 20; A. 57; P. 17; V. 6.

The lateral line commences over the pectoral fin, and after running in a straight course half way down the sides, takes a sudden bend, thence continues straight to the tail. The œsophagus is short and wide; the stomach is of an oval form, and the intestines are entirely destitute of cœca. In this last respect the tadpole fish is an exception in the family *Gadidæ*, where the cœcal appendages are numerous, so as to form one of the principal characters of that family; and it is evident that Cuvier had not been acquainted with its anatomical structure, for

had he been so he would not have placed this fish in the family in which it now stands. A new family ought to be constituted for it, in as much as it differs from the Gadi in having the head covered with scales, as well as in having the intestines free from cœca.



The habits of the tadpole fish are little known, because it lives in a situation where it cannot be observed, and so becomes the subject of examination only when it is removed out of its natural element, or after the death of the animal itself. It spawns in April, and feeds on small insects.

V.—*Observations on the Raptores of South America.* Translated from "Voyages dans l'Amerique Meridionale, par M. Alcide D. D'Orbigny."

The comparative distribution of birds of prey on the old and new continents assigns to the former the vultures, properly so called, and to the latter, the carunculated vultures, or Sarcoramphi. Among the latter, the king of the vultures appears exclusively stationed between the parallels of the tropics, or passes but a short way beyond them, frequenting only woody and warm situations; while the condor, which was held in such consideration by the ancient Incas, frequents the regions of ice and snow, and is by no means exclusively confined to the Andes, as has been hitherto supposed, but is likewise found in cold and undulated tracts, from the south of Patagonia to the line. In this last locality, it occurs successively at all heights, from the level of the sea, where a suffocating heat prevails, to the highest peaks of the Andes, in places where no other living being can resist the rarifaction of the air. Of all known birds, the condor is certainly the one that has the highest flight; and it is probably to this circumstance that it owes the rank near the sun which seems to be assigned to it among the Aymaras and Incas, as the being which made the nearest approach to it. The Cathartes all belong to America, where they inhabit all heights and latitudes (without, however, rising to the same elevation as the condor,) from the frozen regions of the south pole to the equinoctial zone. They

live both on the plains and mountains, and even by the abjection of their manners, render an important service to certain towns, by removing the impurities allowed to accumulate by the negligence of the inhabitants. The remainder of the series of vultures of Linnæus belong to the old world.

We conceive, that we ought to separate from the series of the *Accipitres*, forming the genus Falco of Linnæus, with a view to form them into a sub-family of the Falconidæ, certain species belonging exclusively to America, viz. the Caracara * of Azara and Cuvier, and the Rancanca† of Vieillot, characterized by the disgusting manners of the vultures. They live for the most part on dead and putrid animals, or excrements, which leads them, like the cathartes, to approach inhabited places, and to migrate along with the wandering and savage hordes of the American plains. These birds have been distributed through different genera by that judicious observer, Don Felix de Azara, without regard to the similarity of their manners.

Then comes an extensive series of birds spread over the two hemispheres, the Eagles or ignoble birds of prey of Cuvier; of these the "*Rostrames*"‡ of Lesson first present themselves, which are found only in America, in inundated places, where they go in large troops, employing their singular beak, and disproportionately long claws, to lay hold of fishes. Among the "*Pygargues*,"§ America has likewise its peculiar species. The aguia of Azara (*Falco aguia*, Temm.) is everywhere spread over the cold and temperate regions, frequenting the shores of the sea and the banks of rivers, where it replaces our osprey and sea eagle. The Circaëti, birds nearly allied to our own *Circaëtus gallicus*, Vieill., are also found in both continents; and the only species of large size occurring in South America (*Circaëtus coronatus*, Temm.) is also the only one which braves the pestilential gales of the southern regions which it frequents.

The sanguinary harpy (*Harpyia destructor*, Sw.) which is confined to the numerous warm and humid forests of the American Torrid Zone, is perhaps the most powerful predatory bird occurring in these regions, and is most destructive to the peaceable monkeys, which are sometimes the sole inhabitants of these silent forests. The eagle-hawks (*Spizaëtus*,) inhabit both continents. Those of America frequent countries intersected with woods, and also plains and marshes; even the urubitinga || may properly be considered as a marsh bird. The gos-hawks and sparrow-hawks (*Astur* and *Accipiter*) likewise appertain to both continents. In America, their principal resort is woods and wooded mountains; and they are most

* *Polyborus*, Vieill. † Ibycter, Vieill. ‡ Cymindis. § Haliæetus.
|| Falco urubitinga, Linn. Lath.

abundant in all the countries of the southern continent. The kites (sub-genus *Nauclerus*, Vigors, and *Elanus*, Sauvigny,) are from America and Africa; those of the first sub-genus, at least the *Nauclerus furcatus*, Vig. hovers for whole days over the surface of lakes and marshes. The buzzards (*Buteo*) are also common to the two worlds; but we believe them to be much more numerous in America than in Europe, and even than in Africa, the greater extent of marshes and plains, occasionally tufted with woods, being highly favourable to their mode of life. They are found in all latitudes, from Patagonia to the equator, and from the level of the sea to a very great height on the Andes. The same thing may be said of the harriers (*Circus*) which, pretty nearly allied by their manners, are likewise widely diffused in America, but occur only in woody plains.

The Falconidæ inhabit both continents, but are much less numerous in species in the new than in the old world. They are migratory birds, not more fierce than our European kestril, but extremely well adapted for the chase. After the conquest, they were employed for hunting tinamous; and it is not long since they were used in Peru and Bolivia for the same purpose.

The nocturnal birds of prey, or Strixidæ, included in the Linnean genus *Strix*, which have with propriety been formed into a tribe distinct from the other rapacious birds, are equally spread over both continents. Such relations exist between the European owl (*Strix flammea*) and its analogue in America, that it would be difficult to say exactly whether these species are not identical. The American owls are equally fitted with those of Europe to inspire alarm in the timid. They live in inhabited places, in old houses or churches, and among rocks in the deserts, occupying all latitudes and elevations. The barred Eagle-owl (St. Virginiana, Gm. ?) is found only in the forests of the temperate regions of South America, under all latitudes, representing our large Eagle-owl, (Bubo maximus, Sibb.) of France. The "Cheveches" * (*Noctua*, Savig.) which abound on both continents, occur in like manner under the most different latitudes, and from the shore of the sea to 17,000 French feet above it. All these are noisy birds, and they impart an additional gloom by their melancholy accents, to the vast solitudes which everywhere surround the traveller in South America. There are two species which never approach wooded places, but alight in the immense savannahs, or the arid summits of mountains, and one of them occasionally lurks in the burrows formed by mammiferous animals.† *Scops* belongs to the warm and temperate regions of the two continents.

* "Le type du genre *Chevèche* est le *Strix Nyctea*, Gm." Less. Man. d'Orn. i. 100.

† Perhaps the Ulula cunicularia, Feuill.

By the preceding generalities, it will be seen that almost all the groups of predatory birds are common to the old world and to the new.

To recapitulate, we may state, that the only genera belonging exclusively to America, are, among the vultures, the Sarcoramphi and Cathartes, replacing in this quarter of the world the true vultures, which are peculiar to our own hemisphere; among the Falconidæ the small group of Caracaras, which have no analogues in the old world, and which differ from the vultures only in their forms, for their manners really connect them with that genus. The harpy* and the rostrame† are likewise birds exclusively American, without any analogues in Europe; for none of our eagles are so strong as the harpy, and none of our birds so sociable as the rostrames.

Let us now consider the birds of prey with respect to their geographical distribution, or the number of species which the different localities of South America present to our notice.

We shall divide the whole extent of country to which our observations extend, into three zones; and these three zones shall each be considered in three points of view, namely, in regard to their latitude, their elevation above the level of the sea, and the nature of the countries which compose them.

Our *first* zone extends from the 11° of latitude to the 28°, and in elevation from 0 to 5000 French feet above the level of the sea; our *second*, from 28° to 34° of latitude, and from 5000 to 11,000 feet in height; our *third*, from 34° to 45° of latitude, and comprehends every elevation above 11,000 feet.

The *first zone of latitude*, (that which extends from the 11° to the 28°) besides its immense plains and forests, naturally comprehends the most elevated tracks of the Andes; it, therefore, possesses the greatest number of species; for, independently of such as are peculiar to the warm and temperate zone, we there find the kinds which inhabit a lower latitude, the proportional decrease of heat, as we ascend the plateau of the Andes, soon rendering the temperature of this latitude equal to that of the most southern. Thus when we regard in the aggregate all the species comprised within these two parallels, without taking into account the zones of elevation, we find them amount to thirty-eight, while the total number of species observed does not exceed forty-one. According to this calculation there will only remain for the two other latitudinal zones, three species not found in the first, and peculiar to the southern plains. This proportion will at first appear enormous, but the explanations on which we are about to enter will make it seem less extraordinary.

If we consider, in reference to this first zone, the species confined

* Harpyia. † Cymindis.

to an elevation from 0 to about 5000 feet above the level of the sea, as far as the 12th degree, an elevation of which we believe the mean temperature to be equivalent to that of four or five degrees of latitude without the tropics,—it will be seen, that there must be a deduction from the grand total, of all the species inhabiting this latitude only in consequence of the extreme height of the Andes. The number will thus be limited to twenty-eight, an amount which still approaches to two-thirds of all the species observed. At the same time the species differing, and peculiar to the second and third zones of elevation, give a minimum number of only ten, without including such as likewise inhabit a less elevated zone.

The *second zone of latitude* (from the 28th to 34th degree) by no means presents so many species as the first; but the diminution is gradual, consisting either of the half, if we include all the species found at every height of the latitudinal zone, or of a third only, if we limit the comparison to those of the zone properly so called; for we then find nineteen species, nine of which belong to the plains, and ten to the mountains. Here, therefore, it appears that the number of species is as great, or at least equal, on the mountains; while in the first zone of latitude, the birds of the plains were most numerous. Among these species, four only are proper to the plains, the rest being either alpine or of the third zone.

The *third zone of latitude*, (from the 34th to the 45th degree) comprehends the smallest number of species, for we have not found in it more than seventeen, all of them in the plains or slightly elevated tracks which stretch from the shores of the sea to the foot of the Cordilleras of Chili. The proportion is less than a third compared with the total amount of species in the first zone of latitude, and nearly a half viewed in reference to the number of species of the same zone of which we speak. Among the latter, eight are likewise found on the summits of the Andes, and nine are Patagonian, or frequent either the dry plains or sea shores of the zone.

Let us now consider the distribution of the birds of prey relatively to the height of their abodes, comparing at the same time the species of the zones of elevation with the species of the zones of latitude in regard to the most southern.

The *first zone of elevation* (from 0 to 5,000 French feet above the level of the sea) includes the species which, from the 27° of latitude for example, live always in the plains, but the difference of temperature is so inconsiderable, that all the species, at least such as are not confined to districts of a particular kind, occupy indifferently the lowest and the most elevated situations.

In the *second zone of elevation* (from 5,000 to 11,000 feet above

the level of the sea) we find nine species, of which two only are confined to this region or its localities, the others also belonging to the second or third zone of latitude, where they live in plains where the temperature is nearly the same, and the surface of the country presenting nearly the same aspect as in the elevated zone. Such species have found, in the course of their migrations, regions analogous to those they inhabited in the southern plains.

The *third zone of elevation* (comprehending all heights exceeding 11,000 feet above the sea) presents nine species, among which there is only one Alpine bird, the others pertaining to Patagonia and the Pampas.

From the preceding observations it may be inferred that the birds of prey always follow the same law of geographical distribution as the other series of birds. It is even among them that we most frequently find in the third zone of elevation, or in the third zone of latitude, which corresponds to it, the reappearance of the same species, instead of merely an analogous species, as happens in some genera of the following orders.

The nature of the country must doubtless exercise much influence on the place of residence of every species. Such as range over the greatest extent of surface offer a proof of this. The condor, for example, which extends from the most southern countries as far as the line, never deviates in its migrations from the vicinity of dry and arid mountains ; its appearance in Patagonia is owing to the attractions afforded by the high shores of the sea, the neighbouring mountains of San-Jose, and the analogous nature of the countries to those which are its appropriate abode. The same thing may be said of the Buteo tricolor, D'Orbig. and the Falco aguia, Temm. which belong in particular to mountainous localities. Certain species, however, are exempted from this influence, for the common caracara, and the two species of cathartes, inhabit indifferently, under all the zones, either plains or mountains, provided there exist, where trees are wanting, either bushes or cliffs of rock on which they may perch.

If we examine the distribution of the species in reference only to their particular localities, we will see, for example, that very few of them inhabit the large forests, and when they do so, it is only the outskirts, never the interior, as has been hitherto supposed. The districts which most abound in birds of prey, and which they love to frequent in preference to others, are those that are either slightly elevated, or rather entirely flat, with scattered tufts of wood, extensive marshes, and numerous natural waters, the banks of which are always wooded. Even the great Harpy, (*Harpyia*

destructor, Sw.) which perhaps more than any other species may be considered a forest bird, always follows the banks of rivers.

By dividing all these birds into three classes, and considering the number of species which inhabit, *first*, the wooded lands which we have just described; *secondly*, the arid plains merely covered with small bushes; and *finally*, the mountains; the amount of species in the wooded plains will be thirty-three, that is, more than three-fourths of the whole species observed; in the arid plains it will be nineteen, that is, less than the half of that number, and sixteen, or rather more than a third, for the mountains. It will be understood that these numbers include the species which continually pass from one locality to another.

From all these observations it follows that the number of species decrease proportionally as we advance from the warm regions to the pole, or as we ascend from the low-lying lands of the tropics to the summit of the Andes: and nearly for the same reason, they likewise diminish in their passage from wooded tracks to plains, and from plains to mountains. The following little table affords, in a condensed form, a comparative scale of this system of decrease in the number of species.

ZONES.

No. of zones.	Of Latitude. (Scale of degrees)	No. of species.	Of Elevation. Above the level of the sea (to 15° of latitude.)	No. of species	Of Habitation. According to the nature of the country.	No. of species.
1st,	From 11° to 28°	28	From 0 to 5,000 feet.	28	Woody places, marshes, natural waters.	33
2d,	From 28° to 34°	19	From 5,000 to 11,000 f.	9	Arid & shrubby plains	19
3d,	From 34° to 45°	17	Upwards of 11,000 feet.	9	Elevated mountains	16

It may be asked why the greatest number of rapacious birds inhabit warm regions, and particularly places in which marshes occur and detached tufts of wood. The reason is, that the majority of South American birds of prey do not feed solely on small birds and quadrupeds, like the greater part of European species, but likewise on land and aquatic reptiles which abound in such situations, as well as on fishes and even insects. In America the falcons are the only Raptores which habitually pursue birds and mammiferæ; all the others eat animals of every description; a circumstance which made Azara * suppose that the American birds of prey might share the characteristic indolence of the inhabitants of this quarter of the world. They are in reality much less active than those of Europe, with the exception of the Falconidæ, which every where exhibit

* *Voyages dans l'Amérique Meridionale*, Tom. iii. p. 5.

their characteristic vivacity. This, indeed, is easily accounted for from their mode of life, for they are obliged, more frequently than others, to perch at the margin of waters or on the outskirts of woods, in order to watch the egress of a frog, a lizard, or an insect, which they immediately seize and devour on the ground. They are therefore seldom seen hovering after the manner of our "Jean le Blanc,"* or our eagles; for even the Aguia Eagle and the Buzzards, which hover most, are observed to do so only for a short time in the day, especially in the morning.

We have noticed among many kinds of American birds of prey a sociable instinct wholly unknown to those of Europe, which, with the exception of vultures, never unite in flocks. The vultures of America are as sociable as those of Europe. They assemble in order to devour dead bodies; and the caracaras, their faithful imitators, congregate like them on the same carcases, with a like degree of familiarity and confidence; but in these associations the caracaras are probably more influenced by the desire of obtaining a kind of food common to both, than by any really sociable feelings. The case is different from those assemblies of birds of the same species belonging to other tribes, which move from one place to another in flocks, alight together on the margin of the same lake, perch on the same tree, or even the same bush, in the vicinity of waters and in wooded plains, and rarely separate, at least during their movements over the country; for we are yet ignorant whether they congregate for an annual migration. However this may be, the birds possessing this property are the Cymindis with hooked bills (genus *Rostramus*, Less.) which in this manner continue in company at least for three months in the year, as we assured ourselves by actual observation on the frontier of Paraguay.

The leaden coloured Buzzard (*Falco plumbeus*, Lath.) has the same habits. We have seen them in the skirts of woods resting in large flocks on the same dead tree for a whole day together, some of them pursuing birds and others reposing, the latter taking wing when their companions returned to their perch. It is surprising to meet with this social instinct among birds whose mode of life seems calculated to render them jealous, quarrelsome, and solitary: and, indeed, with the exceptions just mentioned, rapacious birds always live alone without experiencing any of that attraction which brings animals into companionship with others of their kind. Even in the season of love, these voracious birds scarcely remain together in pairs for more than two months, when they again separate and take no further notice of each other. It is true that, during this interval,

* F. brachydactylus, Wolf.

in submission to the law which regulates every sentient being, they appear to become as loving as they are at other times fierce, and share with each other in the toil of rearing their nest; but from the moment the young are sufficiently strong to seek their own food, the couple separate, and appear as selfish and ferocious as before. The more carnivorous they are in their habits, the less does their mode of life dispose them to society; and on no occasion are they seen to live together during greater part of the year, as habitually takes place with many of the Incessores, the Gallinaceæ, Grallatores, and the Palmipedes.

Another kind of union, purely fortuitous, takes place in the immense savannahs of America. The inhabitants are accustomed to set fire to the fields every year, in order to renew the herbage. This conflagration proves destructive to a numerous host of peaceable creatures, which believe themselves secure in their rich plains, from the destructive talons of their mortal enemies. Small mammiferæ, reptiles, and innumerable insects flee in all haste, from these torrents of flame, beyond which myriads of rapacious birds, whose habits usually keep them remote from each other, but which a common instinct of voracity brings together for a short time on this theatre of destruction, are eagerly on the watch. The caracaras, in particular, more numerous, clamorous, and impatient than their companions, dart into the midst of the crackling flames and clouds of dense smoke, while the Buzzards, intimidated by the fire which the caracaras disregard, hover slowly round it in search of their prey, which is often audaciously carried off by the light falcon of more rapid flight, at the very moment they are about to seize it. Nothing can be more remarkable than this spontaneous assemblage of birds, advancing before the rapid progress of the flames, and eagerly disputing for some feeble victim, which already subdued and alarmed, escapes from one calamity only to be overwhelmed by another. When the fire has ceased, all the birds disperse, and each commences for itself a pursuit more easily followed but not less destructive. They run over the burned surface while yet covered with ashes, in order to seek out the half-burned carcases of reptiles and small mammalia, which were unable to escape from the flames; but now, resuming their natural character, they shun the approach of their kind, carrying off their prey in their talons, in order to devour it in some solitary spot, and even then, although entirely removed from their companions, they are seen to look around them from time to time with suspicion and fear, lest others should come to share their bloody feast,—an apprehension from which they are not freed till it be wholly consumed.

In a country where the greater number of birds of prey feed on rep-

tiles and insects, it is curious to see birds belonging to other orders, likewise become carnivorous. Domestic birds are, for the most part, fed with flesh, of which hens and ducks are extremely fond, and it is not merely wild birds which leave grains and insects, their ordinary food, to feed on the flesh which the inhabitants hang out to dry in the sun. We have seen the finches, Icteri, and flycatchers search for this kind of food with a voracity and eagerness which are not natural to them in a wild state, and which can only be attributed to the extreme facility with which they procure it.

The partial comparisons which we have been able to make either of genera or species, show that in the old and new world birds of prey lay a similar number of eggs, and follow the same general mode of constructing their nests, and we do not hesitate to affirm that the markings of the eggs are of the same form, and are generally distributed in the same manner.

In their mode of walking, rapacious birds differ much among the different tribes. Thus the slow and measured pace of the caracaras and vultures distinguishes them well from the leaping of the falcons and buzzards. The birds of the two first series willingly alight on the ground; some of them remain there continually, perching only at intervals, and then upon rocks; while others, although occasionally observed walking, love to pass nearly their whole life in solitude upon trees.

The eagles and the falcons, for example, very rarely light on the ground. They advance to the object of their search by successive leaps: but most commonly they seize their prey on the wing, carry it off in their talons, and go to devour it at a distance. They remain only for a short time on the ground, resume their flight, and perch while digesting their food on the low or elevated branches of trees in the skirts of woods.

The manner of flight likewise differs much in the different tribes. Even among the vultures it varies so much that it would be difficult to assign it a general character. Most frequently, however, the flight is high, rapid at intervals, but rather slow for the greater part of the course. It is among the vultures, and not among the eagles, as Buffon supposed, that birds of the most lofty flight are to be found; for the condor disappears from the sight above the plateau of the Andes, at a point more than 2000 toises above the sea, and at least an equal height may be allowed from the point of its departure; an astonishing elevation, as will be admitted by every one, but which must appear still more extraordinary to an observer who becomes the victim of the rarefaction of the air in regions from 16,000 to 17,000 feet above the sea. Some other birds have a singular habit of whirling about in a particular spot, at a prodigious elevation, from which they

allow themselves to drop down like a ball, making a noise like the whistling of an arrow flying through the air; on approaching the earth they again resume their usual flight. The vultures are in general (for a few species are exceptions to the rule) the only birds which hover at a very great height above the surface of the ground. Some kinds of eagles rise rather high into the air, but they continue there only a short time, preferring the more temperate regions. The buzzards hover in the same manner as the Falco brachydactylus, without, however, traversing a considerable extent of country before reposing, as they do in Europe, which is probably owing to the greater facility with which they obtain their prey. The rapacious birds, which in other quarters of the world are always distrustful, restless, and little accustomed to live in the vicinity of man, seem to shew a disposition to approach him in America. The Cathartes and the Caracaras are never seen in desert places, unless they are drawn thither by troops of large mammiferous animals, such as the Otariæ on the coast of Patagonia. These birds are become the faithful companions of the savage tribes in their migrations, and, as has been already mentioned, they are useful neighbours to the inhabitants of towns, who in some instances have framed special laws for their protection.

The Falconidæ are generally wilder; but some of the typical species take up their abodes in a house or a church, on the summit of which they are seen to alight for an instant, and then dart away to explore the neighbouring country, without appearing to be disturbed by the presence of man.

The Buzzards, and in general all the ignoble birds of Cuvier, or the Aquilinæ, are comparatively less sociable, always remaining at a distance from inhabited places, and even flying off at the first approach of the enemy of all animals, from natural instinct rather than any real apprehension. These birds, however, are much less fierce than the European species, which can be taken only by surprise; they fly to a much smaller distance from man; but the suspicious character peculiar to all carnivorous birds continually manifests itself in all the species of this series. The nocturnal birds of prey follow the same laws as those of Europe with respect to the instinct which leads them to approach our species. The owls of America, (that is, those constituting the modern genus Strix,) like our own, live in buildings, and in the midst of towns, while all the others conceal themselves in thickets during the day, from which they issue in the night to obtain an abundant supply of food in the recesses of the deserts.

We think that we have noticed in the case of certain American birds of prey, a much less striking disproportion between the size

of the male and female, than in those of Europe; a disproportion sometimes so remarkable, that were they not seen paired, an observer might be tempted to consider them distinct species. This disproportion is particularly notable in *Nisus hemidactylus*, Temm. but in most of the other species, it is reduced almost to nothing, and in some instances entirely disappears. The falcons, properly so called, for example, and some buzzards, differ but very slightly in size. We have observed another modification of form in birds of prey, resulting from difference of age. We allude to the greater or less length of the tail in the young and the adult. It is well known that among passerine birds and the Gallinaceæ, for example, the young are entirely destitute of an ornament which is so conspicuous in the adult male; and reasoning from analogy, the tails of rapacious birds ought likewise to be much longer in the adult than in the young. Observation, however, has continually presented us with the contrary appearance, which may be regarded as a character peculiar to birds of prey; the fact being, that among them the tail of the young is always longer than in the adult, the only example of the kind occurring among birds.

A single observation will complete all that we have to offer of these general notices.

Buffon, not without some appearances to justify him, classed the Shrikes among birds of prey, because, although without many of the characters of the tribe, they partly resemble them in habits, since they eat flesh, and even sometimes kill small birds. Azara, on the other hand, thought he had a similar authority for placing the Toucans among birds of prey, because at one season of the year they seek for nests in order to devour the eggs and even young. With accurate views of these improper alliances, Cuvier detached the Shrikes and Toucans from the group of rapacious birds, as belonging to a different series, and reduced it to the subjects which rightly compose it, and which will probably always continue to belong to it. In these circumstances, we cannot fail to express our surprise at seeing our skilful colleague, M. Lesson, place the Cariama or Sariama in this group, merely because it eats reptiles and particularly serpents. May we not object to this arrangement, that the stork, as well as the Sariama inhabits lofty places, and feeds on serpents, although no one has ever thought that it should therefore be placed among the birds of prey? We have carefully studied the manners of the Sariama; and, not to mention its long naked legs, the want of hooked talons, and a beak very unlike that of birds of prey, we can assert that it certainly belongs to the series of Grallatores, of which it possesses all the characters, and among which it was formerly placed. The detailed description which we shall give of this species in its

proper place, will satisfy every one as to the accuracy of this statement.

The following table presents the general division of birds of prey according to our ideas of it, restricted, of course, to the American species.

- Oiseaux de Proie.
  - Ire Famille: Vulturidees. *Vultur*, Lin. .....
    - Sarcoramphes.
    - Cathartes.
  - IIe Famille: *Falconidees.* Falco, Lin.
    - 1re Sous-famille: *Caracarides.*
      - Rancancas.
      - Phalcobènes.
      - Caracaras.
    - 2e Sous-famille: *Aquilérides,*
      - Rostrames.
      - Circaëtes.
      - Aigles-pecheurs.
      - Harpies.
      - Aigles-autours.
      - Autours.
      - Milans.
      - Cymindis.
      - Buses.
      - Busards.
      - Eperviers.
    - 3e Sous-famille: *Falconides.*
      - Falco.
  - IIIe Famille: *Strixidées.* Strix, Lin.....
    - Strix.
    - Ducs.
    - Chevèches.
    - Scops.

VI.—*Characters and Descriptions of the Dipterous Insects indigenous to Britain.* By James Duncan, M. W. S., &c. &c.—(Continued from p. 145.)

Family TABANIDÆ.

Antennæ porrected, approximating at the base, generally three-jointed, the third joint ringed, without any style or seta at the extremity; proboscis and palpi salient and conspicuous; abdomen consisting of seven segments; halteres half-covered by large winglets; wings extended horizontally on each side of the body; tarsi with three distinct pulvilli.

The insects of this family are well known for their blood-thirsty propensities, which instigate them not only to attack many of the larger quadrupeds, but even man himself. In this island they are happily not so numerous as in many other countries, but, owing to the prevalence of a few species, the annoyance they occasion to cattle is by no means inconsiderable. Of the six genera found in Europe, three only have hitherto been detected in Britain. These may easily be distinguished by the following modifications in the structure of the antennae.

- Two lowest joints of the antennae somewhat cup-shaped and unequal; third joint.....
  - 5-ringed..... Tabanus.
  - 4-ringed..... Hæmatopota.
- Two lowest joints of the antennae cylindrical and equal..... Chrysops.

Genus TABANUS.

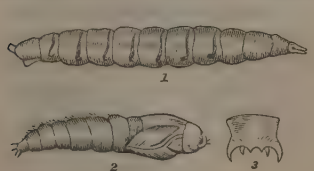
Antennae as long as the head, approximating at the base curved outwards anteriorly, three-jointed ; first joint thick and cup-shaped, second, small and depressed, third, large and thick, imperfectly crescent-shaped at the base, and narrowing gradually to a point, the upper portion divided into four distinct rings, (Fig. 2 ;) trunk horizontal in the male, perpendicular in the female : palpi conspicuous and exserted, two-jointed, first joint short and clothed with long hairs, second capitate in the male, long and attenuated in the female, (Fig. 1, *a*) ; labium large, fleshy, and cylindrical, terminating in two long hollow lobes, (Fig. 1. *g.*) ; labrum long, lanceolate, acute, (Fig. 1st. *b.*) mandibles and maxillæ (the latter wanting in the male,) lanceolate and slender (Fig. 1. *c.* and *d.*) ; tongue narrow and pointed, (Fig. 1 *e.*) ; head transverse, as broad as the thorax, rounded anteriorly, but flattened and somewhat concave behind, and attached to the thorax by a short slender neck : eyes contiguous in the male, a little remote in the female; the facettes largest on the upper side in the former sex : ocelli wanting ; thorax ovate quadrate ; abdomen inclining to conical in the male, wider and depressed in the female ; wings half-open when at rest, furnished with three discoidal cells ; winglets large and circular : tarsi with the radical joint longest, the pulvilli conspicuous, and distinctly three-lobed.

The Tabani are known in this country by the names of *Breeze* and *Horse-fly*. They appear to be the insects called *Œstrus* by the Greeks, and *Asilus* by the Romans, and are frequently alluded to under these names by the ancient poets on account of the terror they occasioned among cattle. They are of strong and robust forms, generally somewhat above the middle size, one of the species being the most bulky of the European Diptera. The prevailing colours are somewhat obscure, with the exception of the eyes, which are of great brilliancy, and often ornamented with rays and spots of crimson and purple. They first appear in the month of June, but are seldom in full force till the middle of autumn. They delight in warm and sultry weather ; are most active on the wing during the

heat of the day, and are therefore most troublesome to cattle and beasts of burden where they stand most in need of repose. They are particularly excited and eager for blood when the atmosphere is in a warm and humid state, such as it usually is after a thunder shower. It is invariably observed to be the females that attack animals, the males being usually found on flowers from which they extract the juices; * both sexes, indeed, have been known to feed on a saccharine liquid. The quantity of blood which they can gorge is much more considerable than might be supposed from the size of the body, as the latter, after a full meal, becomes dilated beyond its usual dimensions. Several of them attack indiscriminately many different kinds of the larger quadrupeds, especially the ruminants, but others, like the Œstri, more particularly attach themselves to certain species. Thus, the rein-deer has a winged parasite appropriated almost exclusively to itself; and it is not improbable that a more extensive knowledge of the history of these flies would make us acquainted with others equally restricted in the choice of their victims.

The oral organs of the Tabani are very highly developed, constituting an apparatus for extracting the blood, of a somewhat complex structure, but admirably adapted to the purpose. It resembles a case of lancets, having all the parts so formed and adjusted to each other, that they serve at the same time to pierce the skin, and to form a tube for the passage of the fluid. Although so dissimilar in shape, these parts are found to correspond in number and situation to the oral appendages of the Coleoptera. The concave lobes of the lip probably enable the insect to attach itself firmly, and to render the apparatus steady; while the palpi are useful in dividing the hair, and form a kind of protecting sheath for the other parts when they are unemployed. In substance the pieces are so stiff and horny, that they easily make their way through the hardest and coarsest hide.

These insects deposit their eggs in the earth. The larva of one of the species, (*T. bovinus*) has been figured and minutely described by De Geer. It is long, cylindrical, and rather slender, narrowing at the head into an elongated cone, and bearing much resemblance to those of some of the larger Tipulidæ which live in the earth.



* The same fact has been noticed in relation to the respective sexes of various *Culices*, and some other sanguisugous species.

The body is divided into twelve rings, the anal one being very minute and resembling a tubercle, (Fig. 1.) The head is provided with two short antennæ and several minute organs, among which the most conspicuous are two scaly hooks, which it employs in opening a passage for itself in the earth, and in aiding its motions. The latter, however, are chiefly accomplished by means of numerous retractile tubercles placed on a dark-coloured band encircling most of the segments, which, by their pressure against the plane of position, preserve the space gained by the elongation of the rings. With the exception of the bands just mentioned, the colour is dirty white, the head brown and shining. The pupa is nearly cylindrical, of a greyish-brown colour, the segments fringed on the posterior margins with grey hairs (Fig. 2.) The anal segment is small, and armed with six sharp scaly points, (Fig. 3.) which seem to enable the pupa to push its head above the surface of the soil, as it is always observed to do, while the lower portion remains imbedded.*

The species of this genus hitherto recorded as British, form but a small proportion of such as are known to inhabit corresponding latitudes on the continent, and it may therefore be expected that considerable additions will yet be made to them. Meigen describes forty-two.

Tabanus bovinus. (s.)

Tab. bovinus, *Linn. De Geer*, vi. 219. pl. 12, fig. 10 and 11; *Fabr. Meigen.* ii. p. 43. *Wood's Illus.* pl. 60.

Ground colour brownish-black; eyes brassy-green during life; antennæ blackish at the tip, and inclining to ferruginous at the base; hypostome, forehead, and all the oral organs, except the labium, greyish-yellow: thorax with several depressions on the surface, clothed with yellowish-grey hairs, and having indistinct dark-coloured longitudinal stripes: scutellum and abdomen of the same colour as the thorax: hinder edge of the abdominal segments with a reddish-yellow band, variable in breadth, and a whitish triangular spot in the middle of each: under side covered with cinereous pubescence inclining to yellow, each abdominal segment with a rather large semicircular black spot in the centre, and a narrow oblique black line on each side of it: thighs and tarsi blackish: tibiæ yellowish-white, more or less dusky at the apex: wings brownish, the costal and discoidal nervures yellowish-brown; winglets and halteres brown. Length 10—12½, breadth 4—4¾ lines.

* De Geer, Vol. vi. 214.

This conspicuous insect, by far the most bulky of our native Diptera, is found occasionally in moorland and uncultivated districts, apparently in most parts of Britain. In Scotland it seems to be of more frequent occurrence in the Highlands than in the southern counties; although numerous specimens have been obtained from the latter. "Sutherlandshire," *James Wilson, Esq.* "Glen Clova," *H. C. Watson, Esq.* "Cardoness, Kirkcudbrightshire." "Monkswood, Hunts," *Charles C. Babington, Esq.* "Not uncommon in Cambridgeshire," *Rev. Leonard Jenyns.* "Ireland," *A. H. Haliday, Esq.*

Tabanus autumnalis.

Linn. Fabr.—Tab. bovinus, *Harris' Expos.* 27. pl. vii. fig. 1.; *Geoff.* ii. 460. pl. 17, fig. 2.; *Meig.* ii. 39.

Considerably less than the preceding, seldom exceeding eight or nine lines: hypostome and palpi light grey, the forehead of the female nearly white with a black line down the middle, dilated beneath into a shining callosity: antennæ black; eyes in the male with a dark line in the middle: thorax pretty thickly clothed with hairs, brownish-grey, with four dark brown longitudinal lines: abdomen greyish-white, with reddish brown reflexions in the male, the first segment brown, the others marked with four series of dark quadrate spots placed obliquely; underside of the abdomen light-grey, inclining to red in the male, with a broad central black stripe, and the segments edged behind with white: thighs black; tibiæ brown, with the base white, nearly all white in the female; tarsi dark-brown; halteres and winglets brownish-grey, the former with the knob white: wings light grey, the nervures dark brown. $7\frac{1}{2}$–9 lines.

Of occasional occurrence in many parts of the country. "Near London." *Stephens's Catal.* "Cambridgeshire, but less abundant than *Tabanus bovinus*." *Rev. Leonard Jenyns.*

Tabanus micans.

Meig.—Tab. austriacus, *Fab.*—Tab. niger, *Donovan.* xvi. pl. 564.

Black; hypostome with grey pubescence; palpi and antennæ pitch-brown; eyes green, with three purple bands, at least in the female; the forehead of the latter grey, with a black spot at the base and vertex, and a longitudinal line of the same colour between them: thorax blackish, with very indistinct light coloured lines, the surface thinly clothed with greyish pubescence: abdomen black both above and beneath, with bluish reflexions; the surface of the first segment with a white pubescent spot on each side, the following segments like-

wise with a white spot on each side, having a faint bluish reflexion, and a white triangular point in the centre ; the hinder margin is likewise narrowly edged with white : legs black ; the anterior tarsi of the male with fascicles of rather long hairs on the outer side ; halteres nearly the colour of the abdomen ; winglets paler ; wings greyish brown, the anterior margin, stigma, and transverse nervures somewhat darker. 7 lines.

A scarce species ; it has been found in the London district.

Tabanus vittatus.

Fab. Meig. Zwei. ii. p. 40.

Prevailing colour dusky brown ; antennæ grey at the base, the terminal joint rufous ; hypostome greyish ; forehead likewise of that colour, the vertex pale brown : thorax thickly covered with yellowish grey pubescence, slate-grey, with a wide brown line in the centre extending over the scutellum, and another on each side somewhat interrupted in the middle ; sides of the scutellum slate-grey, the surface pubescent like the thorax : abdomen blackish-brown, clothed with short yellowish pubescence, and two greyish-white stripes, extending from the base to the apex : underside ash-grey, the abdominal segments narrowly edged with yellow : thighs cinereous, tibiæ and tarsi yellowish : wings greyish, with dark-brown nervures ; halteres grey, with the stalk yellow. 5 lines.

The only notice of the occurrence of this species in Britain which we have seen is that sent us by Mr Babington, who states that he found it in Monkswood, Hunts, June 17, 1828.

Tabanus tarandinus. (s ?)

Hypostome brownish-yellow, with a shining black point in the centre : antennæ rufous, the palpi rather paler, with the apex brown : forehead of the female rufescent, having a black spot on the crown, a larger one in the middle, and three others over the base of the antennæ : ground colour of the thorax black, the surface clothed with reddish-yellow hairs : abdomen deep black, with a band of golden-yellow hairs across the hinder margin of each segment, the bands widening gradually on the hinder segments till they nearly cover the surface ; underside of the abdomen likewise with yellow bands, but narrower than those of the surface, the first segment entirely black : halteres brown ; winglets yellowish ; wings pale brown, the anterior margin and nervures brown, the latter margined with a paler colour : legs rufous, the thighs almost entirely brown. 9 lines.

The native country of this species is Lapland, where it is said to

be very troublesome to the rein-deer. It has been long included in our British catalogues, but we have never seen any particular locality cited for it. It is most likely to occur in the north of Scotland.

Tabanus bromius.

Tab. maculatus, *De Geer.*—Tab. autumnalis, *Harris' Expos.* pl. vii. fig. 4.

Blackish; palpi, hypostome, and forehead nearly white, the latter in the female with a square glabrous black spot at the base, and a line of the same colour in the centre; the crown black; antennæ testaceous, the apex more or less dusky; eyes green with a transverse band of bright purple: thorax marked with five whitish lines, the hairs grey on the back, but inclining to yellow on the sides; abdomen with three series of yellow or greyish spots, the dorsal spots triangular, the lateral ones rhomboidal or oval, and placed near the hinder margin of the segments; the latter with a white edging; underside of the abdomen greyish-yellow with a broad black band, the hinder margins of the segments paler: thighs grey; tibiæ testaceous with the extremity dusky; tarsi black; wing slightly tinged with grey; halteres white at the extremity, the rest black. 6–7 lines.

Of occasional occurrence in many parts of the country. "Near London," *Steph. Catal.* "Monkswood and the neighbourhood of Bath," *Charles C. Babington, Esq.*

Tabanus montanus.

Meig. Zwei. ii. 55.

"Hypostome and palpi yellow; forehead nearly ferruginous, with a shining black semicircular callosity, a black line above it, and a shining point of the same colour on the crown; the space between this point and the line linear and of a reddish-brown colour: antennæ black, the first joint cinereous, the third inclining to testaceous at the base: thorax blackish-brown, with indistinct greyish lines; sides of the breast ash-grey: abdomen brownish-yellow both above and below with a broad black line in the centre, which on the upper side bears a series of yellow triangular spots, and beneath is sometimes mixed with yellow; the hinder margins of the segments are also faintly edged with yellow: eyes with three purple arches, the uppermost extending across the middle: winglets brownish; halteres brown, the apex nearly white: wings clear, with the nervures reddish-brown: fore-legs with the thighs black, the anterior half of the tibiæ ferruginous, the hinder part brown: tarsi black; hinder legs with the thighs grey, tibiæ ferruginous with the tip brown, tarsi dark brown. 7½ lines."

In the want of specimens of this insect, the above translation has been given of Meigen's description. It appears to be everywhere a scarce species, but it has been taken in different parts of England. Mr Stephens indicates it in his Catalogue as inhabiting the vicinity of London.

Tabanus luridus. (s.)

Fallen, Dipt. Suec. 5,4.—*Meig. Zwei.* ii. 55.

Palpi and hypostome greyish-brown, inclining to yellow in the female; eyes brassy green, with three purple bands, the upper one abbreviated and placed near the middle; forehead of the female greyish, with a shining callosity at the angle of the eye, a smaller one on the crown, and a short black ridge in the space between them; two lowest joints of the antennæ blackish, the third ferruginous, with the tip black: thorax and abdomen shining black with dark-coloured pubescence, the former brownish on the sides, the latter having a ferruginous spot, with whitish reflexions, on each side of the three first segments, the anterior ones generally largest, and two or three faint triangular dorsal marks, the hinder margin of the posterior segments narrowly edged with white: underside of the abdomen ferruginous, the base and anus black; halteres dark-brown, the knob white; wings pale brownish-grey; some of the costal nervures edged with brown: thighs and tarsi black, the tibiæ testaceous with the tip dusky, the posterior fringed externally with black hairs. 6–7 lines.

Not of unfrequent occurrence. "Near London," *Stephens's Catal.* "Sutherlandshire and vicinity of Jardine Hall, Dumfries-shire," *Sir William Jardine, Bart.*

Tabanus solstitialis.

Meig. Zwei. ii. 56.

This species approaches so closely to the foregoing as to afford reason for supposing that it is merely a variety. The principal differences consist in the colour of the antennæ, which are rufous with a small portion of the tip black, and in the under side of the abdomen, which has the first four segments entirely rufous, and the remainder black. The rufous marks on the sides of the abdomen are rather large, pale reddish-yellow, with a whitish play of colour: legs dark brown, with the tibiæ reddish-yellow, the apical half of the anterior pair brown. $5\frac{1}{2}$ lines.

Has been found in the London district, but no notice has appeared of its occurrence elsewhere in Britain.

TABANUS TROPICUS. (s.)

Linn. Fabr. De Geer vi. pl. 12, fig. 15–22. *Samouelle's Comp.* pl. 9, fig. 4. *Meig. Zwei.* ii. 61. *Harris' Expos.* pl. vii. 2 ♂.

Palpi and hypostome dark grey in the male, yellowish-grey in the female, the forehead of the latter yellow, with a black callosity at the base, a narrow black line in the middle, and a shining point of the same colour on the crown ; antennæ ferruginous, the apex dark brown : eyes green, with three transverse rays of purple : thorax shining dark brown, with indistinct dorsal grey lines, the pubescence in the male nearly black on the back, and brown on the sides, but entirely ferruginous in the female : abdomen black, the four first segments widely fulvous at the sides, with whitsh reflexions in the male, the centre with a dark stripe variable in breadth, sometimes bearing traces of a pale triangular spot at the hinder edge of the segments ; the latter edged with fulvous ; belly fulvous, dusky behind, the hairs round the sides black in the male, fulvous in the female : thighs dark brown ; tibiæ ferruginous, the anterior brown before the middle, the others generally somewhat dusky at the apex, the intermediate pair with divergent hairs in the male ; tarsi black ; winglets yellowish-brown, halteres dusky, the extremity of the knob white ; wings pale brownish-grey, the anterior margin and nervures yellowish-brown. $7\frac{3}{4}$—8 lines.

This handsome species, which is one of the most common belonging to the genus in many of the more northern parts of the continent, is found occasionally throughout Britain, but is probably more plentiful in Scotland than in the southern districts of the island.

" Near London," *Stephens's Catal.* " Cramond, near Edinburgh," *Rev. William Little.* " Near Berwick," *Dr Johnston.* " Roxburghshire, and Pentland Hills," *Mr Duncan.* " Cardoness, Kirkcudbrightshire."

TABANUS RUSTICUS. (s.)

Fabr. Gmelin, Panzer, Fauna Germ. xiii. 21. ; *Meig. Zwei.* ii. 60.

Male : blackish, covered with yellowish-grey hairs ; hypostome and palpi light yellowish-grey ; antennæ pale ferruginous, with the apex dusky ; eyes of a uniform pale green colour ; thorax and abdomen densely clothed with whitish-grey hairs, sometimes inclining to yellow ; breast and anterior portion of the belly light slate-grey, the hinder part of the latter dull yellow : thighs grey, black at the extremity ; tibiæ yellow ; anterior tarsi black, the hinder pair yellow with the apex black ; wings hyaline, the exterior border tinged with yellow.

Female : forehead light yellowish-grey, with two shining black points, the upper one near the middle, and sometimes prolonged be-

hind into a short line; eyes with an indistinct arched band near the inner side; abdomen marked with four series of dark brown spots; thighs entirely grey. $5\frac{3}{4}$–7 lines.

One of the most common species inhabiting this country; it is scarce, however, in Scotland. "Common in Cambridgeshire," *Rev. Leonard Jenyns.*

TABANUS FULVUS.

Meig. Zwei. ii. 61.—Tab. alpinus, *Shrank,* Fauna Boica; *Curtis* Brit. Ent. ii. 7–8, ♀.—Tab. sanguisorba, *Harris' Expos.* pl. vii. fig. 3.

About the size of the preceding or a little larger, brown, the whole body densely clothed with golden-yellow hairs; palpi and hypostome ochreous, inclining to pale grey; forehead of the female yellow, with a minute black spot near the middle; antennæ entirely ferruginous; eyes greenish, darker on the under side; thorax and abdomen dusky brown covered with thick-set shining golden-yellow hairs, the abdomen with a fulvous spot on each side, extending from the first segment to the posterior margin of the third; under side of the abdomen greyish-yellow; legs fulvous; anterior tarsi and apex of the tibiæ black, posterior tarsi dusky towards the extremity; halteres ochreous: wings yellow at the base and anterior margin, the sub-marginal cell with a rudimentary nerve. $6\frac{1}{2}$–7. (*Woodcut,* Fig. 3.)

Has not been frequently noticed in this country, but as it is rather common in the northern parts of France, it may yet be found in some plenty. "Two females were taken last autumn (1825) by Captain Blomer near Bideford, North Devon."—*Curtis, l. c.* "Norwich," *J. L. Brown, Esq.*

(*To be continued.*)

VII.—*Miscellanea Zoologica.* By GEORGE JOHNSTON, M. D. Fellow of the Royal College of Surgeons of Edinburgh.

"Si Commentariolos spectes, pro viribus egisse me Lectori facile persuadebo. Nec laborem huncce meum defectibus laborare negabo. Modo ad augmentum Sciêntiæ naturalis quædam notatu non indigna neque lectu injucunda contulisse dicar. Et hac ni fallor gloriola me exuet nemo.——Descripsi quædam, et in posterum describam, apud auctores jam obvia, vel quia leviter adtigerunt illi, vel quod nova addenda habeo. Incognitarum tamen rerum pars major erit. Et in istis etiam quæ, nota prius, retracto, fere sine eorum quæ apud alios occurrunt repetitione, nisi ea ad rem necessaria sit, ago."—*Pallas, Misc. Zool. præf.* ix.

I.—An attempt to ascertain *the British Pycnogonidæ.*

The resemblance which the individuals of this family have to the long-legged or "shepherd" spiders (*Phalangium*) led the earlier na-

turalists to classify them in one and the same genus, and it is sufficiently close to justify us in calling them *Sea-spiders,* were an English name necessary for their identification. They are characterized by having a crustaceous slender body, not much thicker than the limbs, and which may aptly enough be compared to a short vertebral column, each segment representing a vertebra with its prominent lateral processes. This column is divided into five segments only, which are so far anchylosed that their joints appear to admit of no motion upon one another, either to a side or perpendicularly: the anterior is rather the largest, and on its vertex there is a tubercle or small wart surmounted by four simple eyes placed in a square, but which are very difficult to detect in some of the species, if they are not actually wanting. I believe that this anterior segment is formed by the confluence of two—a cranial and thoracic, and in the *Pycnogonum,* the evidence of this division may be faintly traced. The cranial portion is sometimes lengthened out into the form of a neck and head, terminated with a short proboscis, but in others the proboscis springs directly from the truncate front into which it is inserted as in a socket. It is a tubular organ, of a crustaceous texture, of extremely limited motion in a vertical direction, and with a simple round or trifid aperture at its apex, but in most of the genera the inferior side is divided into two equal halves by a longitudinal line or plain suture. * Generally at the base of this proboscis we find a pair of *mandibles* formed of two joints, the ultimate armed with a pair of claws or pincers, one of the claws only moveable; and in one genus there is in addition to these a pair of filiform articulated organs, which have been named the *palpi.* All these belong to the cranial segment, if it is allowable to speak of this as distinct. The *thorax* consists of four segments, including the cranio-thoracic; and each of them supports a single pair of legs, articulated with the protuberant sides of the segments. The legs are all alike in form, and calculated solely for creeping; they are eight-jointed, † and the tarsus is provided with one or two strong

* Savigny says that in the terminal mouth we can scarcely perceive some traces of a lip and jaws,—and the manner in which the sentence is worded induces the belief that he could not discover any. Mém. sur les Anim. sans Vert. i. 55. The proboscis of a large species of Phoxichilus, from the Cape of Good Hope, appeared to be composed, says Latreille, of a lip, of a tonguelet, and of two jaws, the whole soldered together. Hence the palpi belong to the jaws. —Cuvier, Règ. Anim. iv. 276.

† The three basal joints constitute the *coxæ,* the next the *thigh,* the two following the *tibiæ,* the other two the *tarsus,* but this nomenclature is objectionable in as far as it is founded on some very doubtful analogies between the parts so named, and the corresponding parts of vertebrate animals.

claws, sometimes aided by smaller subsidiary ones moving in the same direction. The fifth segment is small or rudimentary, cylindric, without appendages of any sort, but perforated at the end with the anus, which is an oval perpendicular aperture with tumid lips: this segment is all that remains of the abdomen, which meets with its extremest reduction in this tribe of crustaceans.

The Pycnogonidæ are all marine animals. They conceal themselves among sea-weed and corallines between tide-marks; under stones within the lowest tide-line; and they are occasionally dredged from deep water. Their motions are remarkably slow, and as it were painful to our apprehension;—hence it is obvious that their prey must be either dead animal matter, or living animals as habetous and defenceless as themselves, an inference which is confirmed by the conformation of the oral organs. We are told that they live principally on the fish of bivalve shells,* which they insidiously enter as these lie gaping in their usual fashion when no danger threatens. Some assert that the Pycnogonum is parasitical on the whale, but perhaps the resemblance which this animal has to the Cyamus ceti † may have deceived the observers, and given rise to the remark, for it is certainly common on our shores where there are no whales; and Fabricius mentions that in Greenland it is found under stones on the shore, just as with us. The females are apparently fewer in number than the males, or are at least much seldomer met with: they are distinguished, as Baster first of all ascertained, by having a pair of spurious legs in addition to those common to both sexes, which originate from the inferior anterior margin of the first thoracic segment, and are appropriated to the purpose of holding and carrying the eggs. These are collected into globular masses enveloped with a thin skin or membrane, each mass firmly adherent to the spurious or oviferous leg, and consisting of a congeries of numerous round ova. There are several masses of these eggs in all the genera excepting Pycnogonum, in which the eggs form a single broad square membrane laid under the body. The changes which the individual may undergo from its birth to maturity are unknown.

* "Mytilorum testasque penetrat et exhaurit. J. G. König," in Lin. Syst. Nat. 1025. Of his Pycnogonum grossipes, O. Fabricius says, "Vescitur insectis et vermibus marinis minutis; quod autem testas mytilorum exhauriat, mihi ignotum est, dum nunquam intra testam mytili illud inveni, licet sit verosimile satis."—Faun. Groenl. 231.

† This resemblance misled Fabricius when he put the Cyamus and Pycnogonum in the same genus.

There has been, and there still is some diversity of opinion among naturalists relative to the place which this family ought to occupy in the "Systema Naturæ." Linnæus placed the only two species with which he was acquainted in the genus *Phalangium*,—a kind of land spiders standing between the mites (*acari*) and true spiders (*araneæ*.) The impropriety of mixing them in this manner with the terrestrial Phalangia was soon perceived; and Otho Fabricius separated them, assigning the name *Pycnogonum* (previously used by Brunnich) to the marine species. He was followed by Muller, the discoverer of some additional species. Fabricius, the entomologist, divided all that had been made known previous to his time into two genera, viz. *Nymphon* and *Pycnogonum;* and Latreille, his immediate successor in the throne of entomology, was at first of opinion that the peculiar characters, especially the tubular mouth of the Pycnogonidæ, justified him in elevating them to a distinct order among his "insecta acera," which includes the myriopods, spiders, and mites. He afterwards saw reason to degrade them from this rank to that of a "family," which he located, after Linnæus, between the phalangoid spiders and the mites. He created a new genus (*Phoxichilus*) for the reception of a species which would not harmonize with those already characterized.* In Lamarck's system, which proceeds from the less perfect to the more complex animals, the Pycnogonides are found in the second order of his Arachnides, characterized by their want of antennæ, by breathing through branched not ganglionated tracheæ, and by having two or four simple eyes. They follow, and are consequently considered superior to the mites and Phalangia; but being associated in one section with the Pseudo-Scorpions they are to be considered cocqual and affined to them,† a conclusion than which nothing can be more erroneous.—Dr Leach, in his first essay, published in the Edinburgh Encyclopedia, made of these animals an order amongst the Arachnides, which he named "Podosoma," and which he divided into two tribes,—Gnathonia and Agnathonia—characterized by the presence or absence

* The changes in their relative position which Latreille subsequently made are immaterial. In the Règ. Animal, they constitute the second, and in his "Familles Naturelles" the first family of the Arachnides Trachearíæ, following the Pseudo-Scorpions and preceding the Phalangia and mites,—a station of the goodness of which he very properly expresses his suspicion; and he afterwards suggests that the Pycnogonidæ should form a particular order, intermediate to the Arachnides and the apterous parasitical insects.—Règ. Anim. iv. 277. Fam. Nat. du Règne Anim. 318.

† Hist. Nat. des Anim. s. Vert. v. 72.

of mandibles. The names of the tribes were subsequently dropped, and they assumed the rank of families, the former being called Nymphonides, the latter Pycnogonides, while the ordinal name was altered to "Podosomata," which, however, was still allowed to stand amongst the Arachnides;* but Dr Leach latterly became so perplexed with doubts and difficulties relative to this family's relationship to other animals, that he dissevered it entirely from the system, and threw them into an appendix.†

Hitherto then the Pycnogonidæ appear to have been considered as insects nearly allied to the mites and spiders. Otho Fabricius had long ago hinted that they were probably of nearer affinity to Crustaceans,‡ but the hint was forgotten until Savigny, by a very ingenious analysis of their organs, arrived at the same conclusion: he believes that they are the group by which nature passes from the Crustacea to the exantennulate spiders, and belonging rather to the former than the latter class. His opinion does not seem to have induced any systematist to alter the usual location of these animals excepting Milne Edwards,§ who has entirely embraced it, and acted upon it. As the question is not one of mere convenience, for, according as our decision is more or less consonant to nature, so will our views be in reference to the distribution of the groups of these classes, I will enter a little into the discussion.

The reasons for arranging the Pycnogonidæ with the Arachnides appear to be these:—1. The general resemblance they have to the members of that class; 2. the absence of external branchiæ; 3. the sameness in the number of legs; 4. the similarity in the position, structure, and arrangement of the eyes; 5. the simplicity of their organization, more especially of the circulating system. At a first glance these reasons are seemingly of great weight, but a narrow examination may shew that they are unsatisfactory. There is perhaps nothing more characteristic of the spiders than the great proportionable size of the abdomen, and the coalescence of the thoracic segments, but in the Pycnogonida the abdomen is reduced to its minimum, while the thorax is much enlarged, and consists of four distinct segments, so that the resemblance between them and some Phalangia is evidently unreal and illusory. The absence of bran-

* Linn. Trans. xi. 387. Lond. 1815.

† Samouelle's Ent. Comp. 305. Lond. 1819.

‡ Faun. Grœnl. 229.*

§ Risso scarcely affords an exception. He places the genus Nymphon amongst the Lemodipodous crustaceans, next to Caprella!—Hist. Nat. de l'Europ. Merid. v. p. 102.

chiæ is admitted, but neither can it be shewn that they breathe through tracheæ after the manner of spiders: it is probable that the aëration of the circulating fluid is effected by the mere contact of the water in which they all live with the external surface, a mode of respiration not unknown among some of the less perfect crustaceans.* To determine whether or not they agree in the number of legs with Arachnides may seem an easy matter, and upon the determination the question of their location mainly depends. If we merely reckon the number of members used for locomotion, the agreement is exact; there are four pairs in spiders, and four pairs in the sea-spiders; but Savigny's researches appear to have proved that some parts have been overlooked which ought properly to enter into the calculation. By tracing, with the hand of a master, the mutations of the organ through the more remarkable families of crustaceans and apterous insects, he first shews that the so-called proboscis of the Pycnogonum is a *head*, without any analogy with the sucker of some acaridans; and were the Pycnogonidæ to be classified with the Arachnides they would be anomalous there; the only cephalous family in the class. The proboscis being admitted to be of the nature of a head, the conclusion necessarily follows that the members, whose true character is concealed under the designations of mandibles, palpi, and oviferous organs, are merely modifications of the legs, which have undergone less change of form than the corresponding legs in many other families of the crustacea; so that, like the crustaceans, the Pycnogonidæ have in reality seven pairs of legs.† "If we attentively examine," says Savigny, "the mandibles and palpi, we must conclude that the family of the Pycnogonum is that in which these organs differ least, either in position or in usage, from the ordinary feet. Their insertion is very far removed from the aperture of the pharynx, which is often placed beyond their reach; the insertion is made not into the head, nor to the advanced segment which supports the head, but immediately to the thorax. The palpi are not attached to any sort of jaws. And what is to be thought of the total occasional suppression or obliteration of these organs? In fact, if the Nymphons have both palpi and mandibles, the Phoxichiles have mandibles only, and the Pycnogonum has neither mandibles nor palpi. These curious facts have been observed by M. Latreille, and by myself, in individuals in his collection.

* Latreille conjectured that the Pycnogonidæ might respire by means of the tubular abdominal segment, as some larvæ are known to do, but the conjecture has no observation in its support.

† Savigny, Mem. sup. cit. 56.

Nevertheless, the three genera seek the same aliment,—they are all equally carnivorous,—an unanswerable proof that the parts to which the names of palpi and mandibles have been given in the Nymphons are not necessarily employed in manducation; that the mouth has its proper existence independent of those parts; that it is essentially composed of other organs,—and this point is so decisive that we may doubt whether the Pycnogonidæ, hitherto arranged with the Arachnides, would not be placed with greater propriety among the crustacea."*

Some naturalists cannot coincide in this suggestion, because of the great simplicity of the anatomy of the Pycnogonidæ, which is very inferior to that of the crustacea. The simplicity of their structure must be admitted; the alimentary canal appears to be a straight intestine extended between the mouth and anus, with some lateral expansions or cœca; and the circulating system is probably reduced to a single vessel which occupies the centre of the thoracic segments, and sends a branch to each member or limb, in which the blood has an irregular movement, but cannot be said properly to circulate. The rest of their anatomy is unascertained. But the argument hence deduced is one which will equally forbid their admission among the Arachnides, for the typical spiders are little less highly organized than the typical crustaceans; and M. Edwards has shown that, by assuming anatomical characters as the basis of classification, the most unnatural combinations would be the result, so that even they who have advocated the superiority of these characters, have found an adherence to their principles quite impracticable in the classification of avertebrate animals. It is a better and safer method to arrange these animals in as many groups as there are distinctly recognizable series formed by the successive simplification or degradation of each distinct organism. In this way we are not arrested by differences of anatomical structure, when these are confined to mere differences of complexness; and, in the instance of the Crustacea, we attach to the class all those species whose general organism, however simple, has no deviations incompatible with that of the types of the class, but which simplicity is, if we may so speak, the result of an arrest to its developement, and recalls by its similarity, the transitory conditions through which the most perfect constituents of the class have passed during the continuance of their embryonic life. To proceed thus may seem to be acting contrary to the recognized principles of natural systems, and one is apt to be startled at a proposal to gather together in one category animals which

* Mem. sup. cit. 75–6.

breathe by gills or branchiæ, with others which have no special organs for the performance of that important function, being reduced to respire by the skin ;—animals which have a heart and a very complicated vascular system, with others which have no heart and no very distinct vessels ;—animals which have a powerfully armed mouth and greatly developed chylopoetick viscera, with others which are sucklings, and whose intestines are fitted for the digestion of no solid food. But these difficulties disappear when we discover how much these organs, so influential in the higher animals, are modified before they entirely disappear in these less perfect beings ;—how they become by little and little rudimentary previous to their obliteration, a loss which is then little felt, and is not accompanied with any essential change in the type of their organization. Branchiæ, for example, become rudimentary and disappear, to be replaced and have their functions performed, by the common integuments in some crustaceans, almost alike, in other respects, to others which are furnished with these organs in a state of high developement, and that too without any notable modification in the other great systems. The blood-vessels cease to have distinct parietes, and exist no longer excepting as simple lacunæ in some crustacea, which it is impossible to separate from other animals of the same class having a very complete vascular system ; and the heart becomes rudimentary, and perhaps even completely disappears, although nothing has occurred in the body generally to reveal its absence. These facts have induced M. Edwards rightly to place in the class Crustacea not only the articulated animals with jointed feet, having a complete circulation and branchiæ—the characters which are usually assigned to it,—but also all those which, formed on the same general plán, are more or less imperfect, and in one sense degraded. The group thus formed will be more difficult to define, but better this than that it should be circumscribed by arbitrary limits. *

Class CRUSTACEA—Sub-class C. HAUSTELLATA.

Order, ARANEIFORMES, *M. Edwards.*

(Podosomata, *Leach.*—Pycnogonides, *Latreille.*)

Character.—Animals crustaceous, araneiform : head rostrate, tubular, the mouth terminal, simple : thorax linear, of 4 sub-equal segments, the anterior with 4 simple eyes placed on a dorsal tubercle : legs 8, exclusive of the auxiliary organs to the head, very long proportionably, ambulatory, raptorious, 8-jointed : abdomen rudi-

* Hist. Nat. des Crust. i. 227–8.

mentary ; anus terminal.—Marine : oviferous, carrying the eggs in masses attached to the spurious legs. The genera are—

I. Pycnogonum. Rostrum without mandibles and palpi ; legs stout, the first tarsal joint minute, the claws simple ; oviferous legs 10-jointed, the terminal joint claw-like.

II. Phoxichilus. Rostrum without mandibles and palpi ; legs slender, the first tarsal joint minute, the claws double, unequal, sharp ; oviferous legs 7-jointed, the terminal joint tubercle-like.

III. Orithyia. Rostrum sessile with a pair of chelate mandibles ; palpi 0 ; legs slender, monodactyle, the firsi tarsal joint minute ; oviferous legs 5-jointed, the terminal joint claw-like.

IV. Pallene. Rostrum raised on a neck, with a pair of chelate mandibles ; palpi 0 ; legs slender, monodactyle, with auxiliary claws, the first tarsal joint minute ; oviferous legs 10-jointed, the terminal joints serrulated.

V. Nymphon. Rostrum raised on a neck, with chelate mandibles and palpi ; legs slender, monodactyle, with auxiliary claws, the tarsal joints sub-equal ; oviferous legs 10-jointed, the terminal joint claw-like.

I. Pycnogonum,* *Brunnich.*

1. *P. littorale.* (Plate xii. Fig. 1, 2, 3.)

Phalangium Balænarum, *Lin.* Syst. 1028. *Mull.* Zool. Dan. prod. 192, No. 2294. *Pen.* Brit. Zool. iv. 43, pl. 19, fig. 7. *Turt. Gmel.* iii. 716. *Stew.* Elem. ii. 326, (the description very inaccurate.)—Acarus marinus seu Polygonopus, *Pallas,* Misc. Zool. 188, tab. 14, fig. 21–23.—Pycnogonum littorale, *Fabr.* Faun. Groenl. 233.—P. Balænarum, *Latr.* Gen. Crust. et Ins. i. 144. *Leach.* in Edin. Encyclop. vii. 413, pl. 221, fig. 11. Lin. Trans. xi. 388. *Sam.* Ent. Comp. 305. *Lamarck,* Anim. s. vert. v. 76. *Savig.* Mem. sur les Anim. s. vert. i. 112, pl. 5, fig. 3. *Stark,* Elem. ii. 203.—Cancellus belgicus, *Walker's* Essays on Nat. Hist. 215.

Hab.—Under stones and amongst sea weeds at low-water mark ; and amongst corallines in deeper water. "On many parts of our coasts, but is not common," *Leach.* Frequent on the coast of Berwickshire.

Description. *Animal* araneiform, of a yellowish-brown colour, naked, finely granulous, the granules almost even with the surface : *rostrum* paler, smooth, thick, conical with a slightly dilated cylindrical apex and trifid aperture,† two thirds the length of the body, porrect or deflected : *cranial segment* coalescent with the next, not produced anteriorly, the back with a large tubercle on which the

* Name from πυκνὸς thick, and γονυ a knee.

† Dr Walker says the mouth "consists of an aperture with four valves."

eyes are placed in a square, the anterior clusters rather more approximated than the posterior: *body* of 4 transverse segments, each armed with a dorsal tubercle along the medial line, and an obtuse one on each side, within which there is a round depression; the posterior margin of the segments elevated, the fourth narrower, obcordate, its tubercle placed forward, while behind it is terminated by the narrow cylindrical *abdomen*: *legs* 4 pairs, the first and second rather longer than the third, and the fourth are still shorter, all of them with 8 joints nodulous at the knees; the three basal *(coxæ)* short, sub-equal, the fourth and fifth twice as long, with two unequal tubercles on the distal ends and a bulged process underneath, sixth joint shorter than the fifth, seventh minute, globular, eighth curved, as long as the sixth, and terminated with a sharp claw,—the joints forming the tarsus covered with a very short hairiness on the under surface.

The female appears to be rare. She carries her innumerable ova, enveloped in a broad square gelatinous membrane or apron, under the body between the legs, where they are attached in front to a pair of filiform jointed organs, which originate from a callous ring that encircles the base of the rostrum. The joints are 10, the 5 basal ones shorter than the others, while the terminal one forms a slightly curved sharp claw.—Linnæus describes the rostrum as being of the length of the feet—"*rostrum* membranceum, subsubulatum, longitudine pedum,"—which, if not an error, might seem to indicate another species.

Fig. 1. The male, nat. size.—2. The female slightly magnified and seen from below.—3. One of the oviferous legs magnified.

II. Phoxichilus,* *Latreille.*

1. *Ph. spinosus.*

Phalangium spinosum, *Montagu*, in Lin. Trans. ix. 100, tab. 5, fig. 7.—Phoxichilus spinipes, *Leach*, in Edin. Encyclop. vii. 412.—Phoxichilus monodactylus, *Lam.* Anim. s. vert. v. 75.—Ph. hirsutus, *Stark*, Elem. ii. 203.—Ph. species, *Cuv.* Reg. Anim. iv. 278. *Leach*, in Lin. Trans. xi. 389.

Hab.—"South coast of Devonshire," Montagu.

Description.—"Body linear: snout long, cylindric deflected: no feelers: eyes four, fixed in a conical tubercle on the top of the fore part of the body behind the snout, placed two forward, two backward, and appear under a microscope strongly reticulated; the tubercle on which they are seated, verrucose: on the back between

* Formed from φοξος sharp, and χειλη a claw.

the hinder pair of legs is an erect cylindric tubercle, which in some point of view might be mistaken for a tail; the summit of this is furnished with two minute spines: legs long, slender, spinous."—"Length of the body a quarter of an inch. Colour rufous-brown.

"The female is furnished with a pair of long jointed appendages, which originate at the fore part of the thorax, and turn underneath, as described by the figure. The use of these antennæ-like members is for holding and carrying about their eggs."—*Montagu.*

Dr Leach, after his brief notice of this species, adds, "Two specimens, which were most obligingly communicated by R. Stevenson, Esq. from the Bell-rock Lighthouse, on the Scottish coast, in a living state, were of a blood-red colour, and are possibly distinct." And after his character of the genus in the Linnæan Transactions he appends the observation—"species multas indigenas possideo, at characteres nondum elaboravi."—*Leach.*

The Phoxichilus spinipes of Lamarck, Anim. s. Vert. v. 75, is a sadly confused species, which it will be found impossible to determine by the most zealous commentator.*

III.—Orithyia,† *Johnston.*

1. *O. coccinea,* (Plate xii. Fig. 4, 5, 6.)

Pycnogonum grossipes, varietas, *Fabr.* Faun. Groenl. 231.—Nymphum coccineum, *Johnston,* in Zool. Journ. iii. 489; and in Mag. Nat. Hist. vi. 42, fig. 7, *b.*

Hab.—Amongst confervæ between tide marks. Not very uncommon in Berwick Bay.

Description.—*Animal* araneiform, slender, of a uniform fine clear red colour, with the joints of the legs and tarsi yellowish, and when magnified a central vessel, distinguished by its deeper tint, is seen running uninterruptedly through the body and legs: *rostrum* yel-

* Lamarck's definition of his "Phoxichilus" is the same as that which I give of "Orithyia," but I could not retain the former name, having applied it to an emandibulate species, after the example of Leach. Some have erroneously described the Phalangium spinosum of Montagu with a pair of palpi, mistaking the oviferous legs for such,—a mistake which has originated from consulting the figure without reference to the description.

† Orithyia—"Dilectâque diu caruit Deus *Orithïa,*
Dum rogat, et precibus mavult quàm viribus uti."
Ovid. Metam. lib. vi. fab. 8.

"——— flerunt Rhodopeïæ arces,
Altaque Pangaea, et Rhesi Mavortia tellus,
Atque Getæ, atque Hebrus, et Actias *Orythia.*"
Virg. Georg. lib. iv.

lowish, porrect, cylindrical, somewhat thickened outwards, divided beneath by a mesial line, shorter than the *mandibles*, which originate from the anterior margin of the first segment, and are biarticulate, the basal joint long, while the second forms a short ovate hand armed with two small sub-equal curved claws: *body* 4-jointed, the first with an oculiferous tubercle, the eyes obscure: *legs* four pairs, with a very few widely scattered short hairs, three times the length of the body, equal, 8-jointed, the basal joint short, the second somewhat longer than the third, the fourth slightly dilated, elongate, fifth and sixth slenderer, but as long, seventh minute, eighth rather long, falciform, spinous on its inferior edge and terminated by a single rather long claw. Length of the body two lines, of the legs six. With a common magnifier the body appears very smooth, but when a more powerful glass is used it and the legs are seen to be roughish with minute granules.

O. coccinea lives among sea weeds between tide marks; and when at rest, with the legs drawn up, it so closely resembles some of the fine-coloured confervæ, but more especially a detached portion of the Chondria articulata, as to be easily overlooked. It appears to me interesting in so far as its transparency allows us to examine its circulating system with an accuracy which perhaps no dissection could enable us to amend. Close to the oculiferous tubercle we see the vessel (for there is no heart) divide into two equal branches, one to each mandible; and the flux and reflux of a fluid is easily observable in them. From the tubercle the vessel runs down the body, giving off a single branch, equal in size to the trunk, to each leg; and this branch continues uninterrupted to the tarsus. Neither in the trunk nor branches could any movement of the fluid be perceived.

The ova are carried under the body of the female, which is comparatively very rare, collected into eight globular packets of a yellowish colour. They are attached to the oviferous filaments which originate from the first segment between the base of the proboscis and the legs, and consist of five joints, the basal one ovate, while the four following are cylindric, elongate, subequal, or rather the terminal one is the shortest. There is no vestige of these organs in the male; nor the slightest trace of palpi in either sex. The segments of the thorax are so prominent at the sides that the coxæ appear to be composed of four instead of three articulations.

Fig. 4. Orithyia coccinea, nat. size. 5. the same magnified. 6. the anterior part of the female seen from below and magnified.

IV.—Pallene,* *Johnston.*

1. *P. brevirostris.* (Plate xii. Fig. 7, 8.)

Pycnogonum spinipes? *Fabr.* Faun. Groenl. 232.—Phalangium spinipes? *Turt. Gmel.* iii. 715.—Phoxichilus spinipes? *Latr.* Gen. Crust. et Ins. i. 144.

Hab.—Amongst corallines from deep water. Coast of Berwickshire.

Description.—*Animal* araneiform, very slender, pellucid and colourless, sparingly hispid, the hairs patent: *proboscis* semiovate, short, porrect, the *mandibles* originating at its base and overtopping it; they are 2-jointed, didactyle, the claws curved: *anterior segment* produced in front so as to form a sort of neck enlarged at the origin of the mandibles: *oculiferous tubercle* between the insertions of the first pair of legs: *abdomen* obsolete: *legs* very slender, cylindric, nearly equal, 8-jointed, the first and third shorter than the second, fourth fifth and sixth elongate, subequal, seventh minute, eighth somewhat falcate, spinous on the inner aspect, armed with a strong moveable claw and two lesser ones moving in the same direction. *Oviferous legs* filiform, 9-jointed, the basal joint short, the second, third, and fourth elongate, the five others shorter, subequal, while the three terminal ones are rather strongly serrulate along one side.

Fig. 7. Pallene brevirostris of the natural size; 8. the same magnified.

V.—Nymphon. † *Fabricius.*

1. *N. femoratum*, "reddish; thighs dilated and compressed." *Leach.*

Nymphum femoratum, *Leach*, in Zool. Misc. i, 45. tab. 19, fig. 2. Linn. Trans. xi, 390. Suppl. Encyclop. Brit. i, 433. *Sam.* Ent. Comp. 306. *Stark*, Elem. ii. 203.

Hab. "In Angliæ occidentali mari. I discovered this species on the shores of the Plymouth Sound, but am indebted to the researches of Mr J. Cranch of Kingsbridge, for the fine specimen from which our figure is taken."—*Leach.*

2. *N. gracile*, "cinereous; thighs cylindric." *Leach.* (Plate xii. fig. 9–12.)

Phalangium grossipes, *Lin.* Syst. 1027. *Turt. Gmel.* iv. 715. *Stew.* Elem. ii. 326.—Phalangium aculeatum, *Montagu, in* Lin. Trans. ix. 101, tab. 5. fig. 8.—Pycnogonum grossipes? *Fabr.* Faun. Groenl. 229.—Nymphon grossipes et aculeatum, *Leach* in Edin. Encyclop. viii. 412. N. gracile, *Leach*, Zool. Misc. i. 45, tab. 19. fig. 1. Supp. Encyclop. Brit. i. 433. pl. 23. *Sam.* Ent. Comp. 306. *Stark* Elem. ii. 203. pl. 6. fig. 17.

Hab.—"Inhabits the British seas every where." *Leach.*

Description.—*Animal* araneiform, very slender, of a pale yel-

* "Hic nunc Emathiæ portus, patriamque revisit.
Pallenen."—Virg. Georg. lib. iv.

† Formed from νύμφη—water.

lowish or greyish colour, pellucid, the legs roughish and sparingly hispid with a spine at the distal end of the femoral joints: *First segment* produced into a sort of neck dilated at the apex where it supports the rostrum, mandibles and palpi; the *rostrum* cylindrical, as long as the neck, divided beneath with a mesial line; *mandibles* biarticulate, the first joint reaching beyond the rostrum, the second short, hispid on the external side, and armed with two claws; *palpi* filiform, 4-jointed, the two basal joints elongated, the others short and hispid: *oculiferous tubercle* distinct: *legs* four times the length of the body, almost filiform and equal, 1st and 3d joints of the coxæ considerably shorter than the second, which is incrassated distally, the thigh and first joint of the tibiæ elongated and equal, the second tibial joint still longer, first tarsal joint half as long as the second, which is hispid and spinous on the inner surface and armed with three moveable sharp claws, of which two are merely auxiliary: *oviferous legs* filiform, long, the two basal joints short, the third and fourth twice as long, the fifth shorter, equal to the sixth, which is rather longer than the three next, which are armed below with a double series of spines, the terminal joint forming a claw: abdomen small, cylindric or slightly tapered posteriorly.

After his description of this animal Linnæus adds—"Mirum tam parvum corpus regere tam magnos pedes." Fabricius says it has the power of reproducing its lost members. "Mutilatur etiam in libertate sua, redintegrandum tamen: vidi enim, in quo pedes brevissimi juxta longiores enascentes, velut in asteriis, cancris aliisque redintegratis."

It may be considered doubtful whether the species figured by us is identical with the Phalangium aculeatum of Montagu, or the Nymphon gracile of Leach, for neither their descriptions nor figures are sufficient to determine the question, and in this uncertainty I have thought it advisable to bring them all together as synonymous, until further inquiries shall shew that we possess more native species, which is most probable. Leach, in his character of the genus, says the palpi are 6-jointed, and the claws simple, while the former appear to be only 4-jointed in our species, and the latter have accessory claws. Some authors have placed Montagu's Ph. aculeatum in the genus Phoxichilus, an error which has arisen from their consulting the figure, which is defective, without reference to the description.

The Nymphon grossipes of Latreille and Savigny, (Mem. ii. p. 111: pl. 5, fig. 2.) is altogether distinct from our N. gracile; and may be known by the joints of the mandibles being nearly equal in

length, by the slender palpi of which the terminal joints are elongate, by the second joint of the legs being more than twice the length of the first, and by the oviferous legs of which the three basal joints are stouter than the fourth, and this again is much stouter than the others, which form a sort of filiform appendage.

Fig. 9. Nymphon gracile, nat. size; 10, the same magnified; 11, the head still more highly magnified and seen from below; 12, an oviferous leg highly magnified.

VIII.—*Remarks on the Reproductive Organs of Pilularia globulifera, and the Globules of Chara vulgaris.* By Mr George Dickie.

Pilularia globulifera belongs to the natural order Marsileaceæ; the essential characters of which are, according to Lindley, "creeping plants; leaves petiolate and divided, (or petioles destitute of lamina,) rolled up in vernation. *Reproductive organs* inclosed in leathery involucres, and of two kinds, the one consisting of membranous sacs, containing a body or bodies which germinate, the other, of similar sacs, containing loose granules." Sir W. J. Hooker gives the following definition of the genus Pilularia: "Involucres solitary, nearly sessile, globose, coriaceous, four-celled; each cell containing two different kinds of bodies; (anthers? and pistils?") The larger of these have been considered as thecæ by Brown, Hooker, Greville, and others. Annexed is a magnified representation of one of the thecæ. The smaller bodies are more numerous than the others, and their shape is simply orbicular; both consist of a tough white membrane. Each of the larger bodies is contained in a reticulated transparent membrane, the smaller are in clusters inclosed together in a similar membrane. If one of the supposed thecæ is ruptured, there issue numerous round transparent particles; these have been considered as sporules. While engaged in examining the nature of these particles, a zealous and accurate observer, Mr Peter Grant, of this place,* suggested to me the propriety of employing chemical tests. I furnished him with specimens, and, on examination, he discovered that the supposed sporules were coloured blue by iodine, thus demonstrating that they are grains of fecula or starch. I have observed that along with the fecula there exists a fluid which possesses all the properties of a *fixed oil.*

The small orbicular bodies have been supposed to be analogous to

* Aberdeen.

the anthers in flowering plants.* They contain a yellowish granular matter, the particles of which, as far as I have observed, possess no definite form. I am not aware that any experiments have been made in order to ascertain the relative importance of these two kinds of reproductive organs in Pilularia ; but in Lindley's Natural System of Botany it is stated, that Professor Savi of Pisa found that in Salvinia, belonging to the natural order Marsileaceæ, the seeds so called, and the supposed small globules, must both be present to produce germination in the former. Duverney, on repeating Savi's experiments, has, however, observed that the seeds when separated from the small particles, were capable of developement. The presence of *fecula* and *oil* in the larger reproductive bodies of Pilularia would seem to indicate an analogy between them and the seeds in flowering plants.

Recently, while examining the globules and nucules of Chara vulgaris, I remarked, that the former of these contain in many instances round transparent particles intermixed with the filaments. These particles give a blue colour with iodine. The presence of fecula seems, however, to be of rare occurrence in the globules, as it is much more frequently absent than present. Dr Greville describes the nucule as being " sessile, oval, solitary, spirally striated, having a membranous covering, and the summit indistinctly cleft into five segments ; *the interior is filled with minute sporules.*" These so called sporules are particles of fecula, which may easily be demonstrated by bruising a nucule in a drop of water under the microscope ; the round particles which issue will be found to possess all the physical characters of fecula enumerated by Raspail, and finally, the addition of a drop of solution of iodine will decide their nature. Along with the fecula in the nucule, a *fixed oil* is also present.

* Lindley suggests that they are abortive sacs analogous to the larger bodies.

REVIEWS AND CRITICAL ANALYSIS.

I.—*A History of British Fishes.* By WILLIAM YARRELL, F. L. S. Illustrated by Wood-cuts of all the Species, and numerous Vignettes. 8vo. 2 vols. J. Von Voorst. London, 1835, 1836.

"THE large and constant supply of excellent food obtained from the seas all round the coast by moderate labour and expense, and the employment afforded to a numerous and valuable class of men, who become not only good seamen but able pilots, since the successful exercise of their occupation depends on an intimate knowledge of the nature of the ground surface, the situations of banks and channels, with the particular direction and force of tides and currents, render the British fisheries, in many points of view, a branch of political economy of great national importance."* Such is Mr Yarrell's recommendation of his favourite pursuit, and we cordially agree with him in its importance. Ichthyology has ever been with us a favourite study; in all its branches we delight, though we may plead guilty to a slight partiality for the "gentle art of the angle," as Isaac hath it, or, in other words, to the practical more than the theoretical departments of the science. It is a study, moreover, which is better calculated to lead the mind to that of more exalted things than perhaps any other branch of the Vertebrata. The medium in which the creatures move is of difficult and uncertain access; there is a mystery in ocean's depths which whets the innate curiosity of man; yet, whether it is pursued on the open sea beach, by the banks of some noble lake or stream, or along the devious course of some wild and noisy torrent, there is a serenity of mind induced favourable for meditation, leading from the bright and glittering prey,—the object of the sportsman's ardour,—to the contemplation of its Maker; and the thoughts almost invariably turn to the tenants of more ample waters, the myriads of creatures,

> Strange forms, resplendent colours, kinds unnumbered,
> With swords, saws, spiral horns, or hooked fangs,

* Mr Yarrell's Preface.

wonderful, most wonderful in structure, that swarm in the expanse of the mighty waters which are placed on the surface of the world. And will it not be accounted strange, then, that it has only been since the commencement of the present century, that the study of this interesting and important class of living creatures has really received an impulse, and has begun to be examined by the same principles and careful analysis to which the other sections are subjected.

Looking to the early literature of the science generally, we have various writers, of as varied fame and talents, touching upon the natures of fish in their historyes and poetry; but they were more taken up with the dieteticks of the art, than with the structure of the creatures. So was it also in the olden time of British story. The stews and vivaries occupied the most attention, and in the record of an accurate and quaint historian, "as every water hath a sundrie mixture, and therefore is not stored with every kind, so there is almost no house, even of the meanest tounes, which have not one or mo ponds or holes made for reservation of water instored with some of them, as with tench, carpe, breame, roach, dace, eeles, or such like, as will live and breed together."* The middle of the sixteenth century, perhaps, affords us the first names which can be quoted as scientific. Belon, Rondolet, and Salvianus are sufficiently known. Between the dates of the works of these authors, to nearly the middle of 1600, we find many which have treated partially of Ichthyology; and about the same period, the compilation of Johnson gave a kind of new zest to the subject in this country. Two British names, however, of the same age, but a few years later, did more for the advance of the science than all which had been previously achieved,—more, perhaps, every thing considered, than has even since been accomplished. Reducing from a chaos the observations of their predecessors, they produced an arrangement which has allowed their followers to re-arrange with comparative facility, and which, in fact, constitutes the basis of the systems which were afterwards proposed, while their descriptions of formerly known or newly observed species are characterized with a greater degree of accuracy. It will easily be perceived that we allude to Willoughby and Ray, names inseparable from each other, and from the history of British Ichthyology.

From the date of the works of these excellent men to the middle of 1700, there appears a wide gap, so far as the literature of the

* Holinshed, Hist. of England. The necessity of having a regular supply of fish during Lent and other Catholic holidays, may account for the remarkable attention paid to the breeding of them in these early times.

science is connected with the inhabitants of the British waters. Linnæus and his pupils, and Artedi, were much indebted for their information to the naturalists of this country. But it is not, we believe, until the appearance of the British Zoology of Pennant in 1769, that we can lay claim to any work devoted to the history of our native fishes. Subsequent to this, we have again only partial accounts and treatises scattered in the periodicals of the time, and in the works of Banks and Solander, Forster, Gmelin, and Shaw. But in comparative anatomy, the age was more fertile, for Cheselden, the Hunters, and Monro secundus, gave to the world the results of their researches, which have kept their place to the present day.

In the conclusion of the eighteenth and beginning of the nineteenth centuries, it was evident that the science was slowly and quietly gaining ground. Berkenhout's last edition contained a "Synopsis of the Natural History of Great Britain and Ireland;" Shaw was occupied with the Ichthyological part of his General Zoology; Low described several northern fishes in his Fauna Orcadensis; Montagu read some interesting papers to the Wernerian Society; and an industrious naturalist commenced and completed a work of much merit. This work of Donovan, begun in 1802, was published in numbers, and forms five 8vo volumes, with coloured plates of 120 species. Many of the figures are remarkably good, and the descriptions are often accurate, but the price was much beyond the reach of the general purchaser, and this excluded it from the library of the student. Turton's Compendium of our Fauna, indeed, might easily have found a place there, had not the very unattractive appearance of his little volume, and the dry nakedness of the compilation, and its inherent want of value, been as effectual to its non-admission as a prohibitory price. Fleming's British Animals in 1828, gave the next most complete synoptical arrangement of our fishes;* after which our progress was marked by many excellent papers in our periodicals and transactions, in which Montagu continued to contribute, and the names of Couch, Fleming, Neill, Jardine, and our author, bore prominent parts; discoveries and additions were making rapidly, and a work of moderate size and moderate price, giving a connected view of the latest acquisitions, with figures and descrip-

* We should not neglect here the important attempt made in the same year by our learned countrywoman, Mrs Bowdich, to illustrate the fresh water fishes of Britain by drawings and descriptions. The manual labour required by the manner in which the work was prosecuted was much too great, while other circumstances stopped its publication before it could be of use to science.

tions of the species which claimed existence in the seas and rivers of our islands, was, in 1835, anxiously called for.*

Happily, we can now introduce a work which will supply this vacancy; but in doing so, it were ungrateful not to remember and mark the debt we owe to the genius of Thomas Bewick, for certainly his volumes created the taste and demand, which is now so prevalent for similar productions. The felicity of expression which pervaded all the figures of that artist, and the fidelity to nature with which they were drawn, won their own way, and in a short period diffused more taste for, and knowledge of, British ornithology, than the more expensive or beautifully illustrated publications of our countrymen. Their price was moderate, and they were understood by the young; we have, night after night, in our early days, watched the arrival of the gamekeeper, whose orders were to bring in every thing, and, Bewick on our knee, compared the contents of the bag with his living pictures. Winter was a glorious time; hard frost, and less cultivation than at present, rendered wild fowl abundant; and some species were frequent, which now are to be seen in the vicinity only at intervals far and wide between. These books gave a general love for the subject; annotations and comparisons were made, which grew into new discoveries and materials for new Faunas; and we foresee the time when the work before us will produce similar effects. Fishes are already sought for (and have been found) which are not in "Yarrell's work." It is, indeed, a "worthy work." Wood-cutting in Bewick's day was but in infancy; and had it not been touched by his own hand and peculiar spirit, it might have yet remained so. Here we have it in its matured state; and, looking to the volumes with the eye of an artist, we should say the art is almost complete. But we must offer our congratulations to the public upon another part. The typography and wood-cutting we look upon as the shell; let us see if the Mollusc will grace its covering? It is a little more unobtrusive, but more minute examination displays its structure. The letter-press of Mr Yarrell's volumes has sufficient of popularity mixed with its texture to render it easily understood by all readers, while the dignity of science has been throughout maintained. The descrip-

* In omitting the title of Mr Jenyns's useful manual, we are not unaware of its importance, but it appeared nearly contemporary with Mr Yarrell's work, and the notes of that gentleman were confessedly much employed in it. Neither are we blind to the new era commencing with the works of Cuvier and Valenciennes, and Agassiz; but their importance, though lending an aid to local Faunas, will be much more universally diffused.

tions are plain, simple, and unaffected; entertaining enough for the general reader, distinct and detailed for the man of science,—can we say more? When we earnestly recommend it to the British student as the best guide to the Ichthyology of his country, and to the scientific naturalist abroad as a work of much utility, perhaps its author will be satisfied.

Having thus given our opinion of this excellent "History," let us go into a little detail; make our observations as they were noted in reading through the book; pick a fault or two, and exhibit a specimen of our author's style, which may excite the few naturalists who want the work, to add one to their libraries which, so far as British Ichthyology is concerned, we deem indispensable.

The volumes open with the Percidæ and the common perch, a beautiful fish and a beautiful figure. With the account of its distribution we differ from our author; "and in this country there is scarcely a river or lake of any extent where this fish does not occur in abundance. It is found in most of the lakes of Scotland."* This will do for the waters of the south; but in the north of England it is a rare river fish, still rarer in the same localities in Scotland, only sparingly met with in the lochs north of the Forth, and in one or two places where it is found north of Perthshire, we can trace its introduction at no distant period. In all the almost countless waters of the northern counties the perch is wanting. Minnow is a deadly bait for large perch. Couch's Serranus (*Ser. Couchii*, Yarr.) dedicated to the indefatigable ichthyologist of Cornwall, though formerly noticed in the Linnean Transactions, is figured for the first time, and has not been identified with any of Cuvier and Valenciennes's species. The details and anatomy of this fish are, however, still wanting, Mr Yarrell having wrought from a drawing only. The weevers, *Trachini*, follow; curious fish, and dreaded by ordinary fishermen. The wound by the dorsal spines of T. draco seems to have varied effect on different constitutions. Some, we have heard, laugh at it, others describe the pain as intense and burning. It is best to beware; and in the French markets, where it more frequently appears than in those of Britain, a penalty is inflicted on those who sell the fish without previously cutting off the dorsal fin, which, as Drayton has it, "buyers seldom see." The lesser species seems common on all our sandy shores, and certainly seldom exceeds five inches in length; in the Solway Frith dozens are taken every tide by the shrimpers. The wounds inflicted by the fin and cheek spines seem only to produce slight inflammation around

* Vol. i. p. 2.

the wound, with a tingling pain. Of the Gurnards, *Trigla*, six species are figured, and one is dedicated to Bloch to prevent confusion in the application of "Cuculus," which that naturalist and Linnæus had given to different species. Mr Yarrell remarks, that they mostly swim in deep water, and are taken by the traul-nets. The grey gurnard, by far the most abundant on the western coasts of Scotland, often delights on the surface. We recollect observing the sports of shoals of this species when on an excursion to the Western Isles, during a week of beautiful and too calm weather, for it was before steam-boats plied. They were often discovered by their noise, a dull croak or *croon*, whence most probably their provincial name of *Crooner*, or by the ripple or plough of their nose on the surface of the calm sea; thus they would swim for a few yards, and then languidly sink for a foot or eighteen inches, display and stretch their lovely fins, and again rise to the top. Boats were out with hand-lines, almost all were half-full, the men having little to do but bait the hooks and pull up. We resorted to our guns, and killed sufficient for dinner from the deck of the vessel. *Cottus gobio* is rare in Scotland. *C. scorpius* is badly represented; there are two lateral lines strongly denticulated in the figure, which we vainly look for in the fish itself. The *C. bubalis*, on the contrary, is an exquisite figure, full of life and expression. *C. quadricornis* is given, for the first time, as British, from a specimen in the National Collection. *Aspidophorus Europæus* is not uncommon in the Solway. We have two species of *Gasterosteus* new to Britain, one from Ireland, the other from the vicinity of Edinburgh; and from the small size and close alliance of these beautiful, but not very useful fish, we may yet look for other additions. The Mackerel is exquisitely cut. Mr Yarrell's observations on its migration are interesting, and afford a good example of his writing.

"The mackerel was supposed by Anderson, Duhamel, and others, to be a fish of passage; performing, like some birds, certain periodical migrations, and making long voyages from north to south at one season of the year, and the reverse at another. It does not appear to have been sufficiently considered, that, inhabiting a medium which varied but little either in its temperature or productions, locally, fishes are removed beyond the influence of the two principal causes which make a temporary change of situation necessary. Independently of the difficulty of tracing the course pursued through so vast an expanse of water, the order of the appearance of the fish at different places on the shores of the temperate and southern parts

of Europe, is the reverse of that which, according to their theory, ought to have happened. It is known that this fish is now taken, even on some parts of our own coast, in every month of the year. It is probable that the mackerel inhabits almost the whole of the European seas; and the law of nature, which obliges them and many others to visit the shallower water of the shores at a particular season, appears to be one of those wise and bountiful provisions of the Creator, by which, not only is the species perpetuated with the greatest certainty, but a large portion of the parent animals are thus brought within the reach of man; who, but for the action of this law, would be deprived of many of those species most valuable to him as food. For the mackerel, dispersed over the immense surface of the deep, no effective fishery could be carried on; but, approaching the shore as they do from all directions, and roving along the coast collected in immense shoals, millions are caught, which yet form but a very small portion compared with the myriads that escape."*

The Dory, *Zeus faber*, is considered rare on the northern shores; Dr Johnston has seen two specimens taken on the Berwickshire coast. *Zeus aper* is added to the Fauna, or rather authenticated to it, a second specimen having occurred in the Bridgewater-market in 1833.——*The Mullets.* Surely there is some confusion here. *The thick-lipped grey mullet*, reckoned so rare by Mr Yarrell as to have been seen only once by Mr Couch, is the common species on the eastern shores of Scotland, where we believe his grey mullet is not known at all, or is, at least, far from common. At the mouths of rivers the former is taken in considerable numbers in autumn, and the figure borrowed from the Italian Fauna, represents this fish with accuracy. But is it not synonymous with the "grey mullet" of Pennant? A comparison of the figures brings them very close. *Mugil labrosus* of Risso is certainly also doubtful as a synonym. *M. curtus*, Yarr. has been taken a second time by M. Baillon in the bay of the Somme, near Abbeville. It is curious that in this instance one specimen only, was also seen.—Valenciennes is of opinion that Mr Yarrell's characters are good. Among the Blennies, *B. palmicornis* of our author, was sent from the Berwickshire coast, and a single specimen procured by Dr Johnston is the only one which has been seen by Mr Yarrell; but what makes it still more interesting, is, that M. Valenciennes, in his last volume, con-

* See p. 121.

siders the fish here represented as new altogether, and as distinct from the B. palmicornis of the Mediterranean, which has never more than from 33 to 35 rays in the dorsal fin, while that in question, now *B. Yarrelli,* Val. has 50 or 51. The wolf-fish, *Anarrhichas lupus,* does not please us in its figure; the limner has been left to himself, and it would seem that in his eye the sea-cat was imperfect without the head of a real cat. The beautiful gemmeous dragonet we also dislike; it does not exhibit the best style of the art, and looks as left unfinished. We agree with Mr Yarrell in considering it distinct from the sordid dragonet. The *Labridæ* are interesting, and some beautiful figures are given in their illustration. There is an error relative to the *Crenilabrus Cornubicus,* or Goldsinny, but we refer to our 167th page for its correction.

Of the *Cyprinidæ,* a difficult but most interesting family, we have comparatively few species in the north. The carp, the barbel, the gudgeon, the tench, with many more, are all wanting; the sluggish streams of the south being more favourable for their breeding, and more pleasing to their habits, than the torrents of alpine districts. The common bream will be the most numerous of the group, being abundant in many lakes of southern Scotland, but they all disappear towards the north, and the Grampians perhaps limit their range in that direction. *Abramis brama* and *blicca* are common in the Lochmaben lochs. *Leuciscus idus* we have been unable to trace in Dumfries-shire, though it is introduced on the authority of the late Dr Walker as taken at the mouth of the Nith. *Leuciscus dobula,* Mr Parnell writes us, has been discovered in the Cumberland rivers.——*The Pike.* The lakes of Scotland have produced some 55 lbs. weight.* The weight is rather underrated; we have seen a record of a pike taken in Lochlomond 79 lbs.——The *Salmonidæ.* This most beautiful, but most difficult group is on the whole well represented. The Parr we must criticise a little. The cut is not characteristic, the maxillary bone is far too long, and destroys the peculiar character of the head. The salmon is good, a fine fish: and then such trout! What sport on single gut at the end of Mackenzie's best, in one of Scotland's gullies! Mr Yarrell in his account of the Salmonidæ, has condensed all our previous scattered information, and is in this most useful; he treads his ground otherwise tenderly, and feels like ourselves the want of facts and accurate observancies. We may notice a slight error, however;

* P. 387.

" During the early part of the season, the salmon appear to ascend only as far as the river is influenced by the tide, advancing with the flood, and generally retiring with the ebb."—Many salmon ascend during spring; in the Tweed, for instance, thirty or thirty-five miles, and are taken at that distance from the sea clear and silvery, and in full condition, in the months of February and March. There is, also, undoubtedly, a species omitted, which, though migratory, ascends but little way up the fresh water, and which, with its provincial name of salmon trout, has done much towards confusion.* *S. trutta* and this have to be separated, and we would recommend, to determine the characters, and then fix the synonyms; the reverse has hitherto been the common course pursued. Mr Yarrell has, we think, satisfactorily made out two species of Char; the one from the lakes of northern England and Scotland, the other from Wales. Of the *Coregoni* no figure of Mr Thompson's Pollan, *C. pollan*, is given, and we refer to our own page, 247, for its more detailed description. We strongly suspect that this fish is identical with the powan of Lochlomond and some others of our Scotch lochs. Have we any authenticated instance of the gwiniad occurring in Scotland?——*Clupeadæ*. The scaling of the herring is surely represented much too large. This fish takes the artificial fly readily, and is thus caught in the Western Highlands in considerable numbers. The account of the Pilchard from the Couch MSS. will be found very interesting.——*Raniceps trifurcatus* is now found to be not so rare as it was formerly accounted; many instances of its occurrence in various seas having been lately noticed.† A tolerable figure of this fish occurs in Muller's Zoologica Danica, under the name of Blennius raninus, which seems to have been overlooked by both Yarrell and Jenyns.—Among the *Pleuronectidæ* it may be remarked, that many species select some particular shell-fish for food; thus the *Dab* was noticed long ago by Peter Colinson to feed on the Pecten obsoletus, a fact since confirmed by Dr Johnston, who informs us, " that he has rarely opened a specimen without finding the stomach full of this pretty shell." The *Platessa microcephala* again feeds much on Chitons, while the clam is seldom found in it. Mr Yarrell describes four species of eels, three of them very distinctly marked; and we can only account for their remaining so

* The *Salmon Trout* at Berwick is the young of S. eriox, quite a different fish from that now alluded to.

† See a paper in the present number on R. trifurcatus, page 344.

long confused, by a reference to the prejudice or disgust that is associated with them, existing even in the south, and as we proceed northward not to be overcome; albeit we Scotch are not famous for squeamishness or delicacy. Of *Acipenser* we have one species only noted, but it is more than probable that some additions will be made ere long to this genus; the species of the continental seas are closely allied, and the occurrence of specimens on the British coasts being comparatively rare, their distinctions have necessarily been scarcely investigated. *Scyllium melanostomum* is added from a drawing of Couch. The volume concludes with the account of two most remarkable creatures, the *Myxine glutinosa*, found chiefly on the east coast, and far from uncommon in the vicinity of Berwick;* and the Lancelet, *Amphioxus lanceolatus*, Yarr, supposed to be the example of lowest organization among fishes—rare and singular. So much for our notes.—We conclude by repeating our recommendation of Mr Yarrell's volumes, and wishing them every success.

II.—*A Catalogue of British Plants, arranged according to the Natural System, with the Synonyms of De Candolle, Smith, Lindley, and Hooker.* By the Rev. J. S. Henslow, M. A. Professor of Botany in the University of Cambridge. Second Edition, 12mo. pp. 64, 1836.

Were this only a catalogue of names and synonyms, as indicated by the title, we should consider it a useful addition to the library of the British Botanist; and one particularly required at the present time, when changes in nomenclature are so frequent and confusing. But the usefulness of the work is by no means limited to that of a mere compilation of names, the catalogue being made instrumental for conveying important suggestions and improvements in matters interesting to botanists, particularly with regard to those much disputed points, the *indigenousness* and the *specific distinctness* of our wild plants. In reference to the latter question a threefold division is followed, namely, *species,—questionable species,—varieties;* the latter being again distinguished according as they are elevated to the rank of species by one or more of the authorities above named. The author's divisions under the former

* See a most important and elaborate paper on the Myxoideæ in the Transactions of the Royal Academy of Berlin, by Muller, of which we give an analysis in the present number, p. 402.

consideration, or the degree in which the species may have claim to be held indigenous to Britain, are fourfold, and are indicated by particular marks, namely, *species "possibly introduced by the agency of man"*†—*"Naturalized species, certainly not indigenous"**—*occasionally found wild, but not even naturalized, extinct, or erroneously introduced, and which ought to be excluded from our Floras"* (o) ;—*admitted natives.* The species included in the *Flora Cantabrigiensis* are distinguished by the addition of a letter (*c*,) and the goodness of their titles to be considered natives of the district, to which this Flora relates, is also indicated.

On the very debateable question touching the identity or distinctness of species, it is in vain to expect uniformity of judgment, while mere opinion, in contradistinction to fixed rules, is the only guide for our decisions. No fixed rules have yet been discovered or admitted, and we might add, probably with equal truth, that no fixed rules ever will be discovered. The subdivisions of genera, or (what is the same thing,) the union of varieties into species, must rest on the ground of expediency, so long as absolute rules are wanting; and, viewing the question in this light, we unhesitatingly recommend the *catalogue* of Professor Henslow as the best guide for the botanist of Britain ; agreeing with the Professor's suggestions in most instances, though inclined to sink the majority of his questionable species into the grade of mere varieties. We do not, however, so fully agree with the manner of classifying the species not indigenous or not found at all in Britain. It appears a more judicious course to join the species "occasionally found wild," with the "naturalized species," both classes being "certainly not indigenous ;" and the difference between them being one of degree only, where the degrees are so very difficult to distinguish, that no uniformity of opinion can be hoped for. The classes of extinct and mistaken species are readily separable from the preceding, since these species are not found wild in any sense of the term. They are, indeed, equally different from each other, yet cannot be completely separated ; it being now quite impossible to decide whether several of the species, the names of which are still included in our Floras, have become extinct ; or whether such names were introduced originally through some mistake about the plants to which they were applied. It would be well to expunge from our descriptive Floras the names of all species not now found wild. The remainder would unite into two classes,—*the wild, but certainly introduced* ;—*the established, of uncertain origin.* The subdivisions of these two groups would be merely those of degree. In the former, the extent to which the species have become natu-

ralized; in the latter, the amount of suspicion touching human agency in their introduction, would be the proper criterion. The whole question is still quite open to discussion, and we hope that the example, set by Professor Henslow, will stimulate others to pursue the same subject.

We cannot devote the space necessary to give many examples of our author's views, but the selection of a few genera will render the plan sufficiently intelligible. The genus *Fumaria* has six varieties and species, all of them being marked as belonging to the "possibly introduced" class. *F. officinalis* and *parviflora* are given as admitted species; *capreolata* and *Vaillantii* are held to be questionable species; *media* and *leucantha* are considered to be varieties; the former being distinguished as one admitted to be a species by De Candolle. In the genus *Papaver*, we find *P. nudicaule* considered as a species that ought to be altogether expunged from our Floras; *somniferum* is marked as a species certainly introduced, the other four,—*hybridum*, *argemone*, *dubium*, *rhœas*, rank as possibly introduced species; the maritime form of *Argemone* being named as a variety of that species. *Tormentilla reptans* is sunk into a variety of *T. officinalis*, which latter is properly referred to the genus *Potentilla*. *Oenanthe apiifolia*, in like manner, is joined to *O. crocata*: *Veronica agrestis*, *polita*, and *Buxbaumii* are all admitted species; the latter being considered as certainly introduced. *Potamogeton oblongus* is rejected; *lucens* and *heterophyllus* are united as two varieties, under the name of *proteus*; *rufescens* and *lanceolatus* are questionable species.

The author gives a numerical table of British species, &c. so far as his Catalogue extends, that is, to the Algæ inclusively. Of the Acotyledones, 1406 species, or 1583 species and varieties together, are enumerated. The Phanerogamæ are thus stated:

	Species,	*or with Varieties.*
Indigenous (including the possibly introduced,)	1382	1650
Naturalized,	57	62
To be expunged?	56	58
Total,	1495	1770

It is deserving of notice, that the author of the Catalogue has altogether discarded the use of capital letters in writing specific names, while in the last edition of the British Flora, the use of capitals in this way has been considerably extended, by adding them to all adjectives expressing the names of countries, as *Gallica*, *Anglica*, &c. The omission of capitals gives a neater and less crowded appearance

to lists of names, but it may be questioned whether their utility in affording hints and information to students, should not be deemed a sufficient counterpoise to any disadvantages arising from their use. We care little for the grammatical, or rather scholastic accuracy of either method; its usefulness is the proper question. But we should be glad to see scientific writers keep uniformity in this respect; and we would remind botanists that they cannot determine this point by themselves; it is a question equally applicable to zoology as to botany.

III.—*The Northern Flora; or a Description of the Wild Plants belonging to the north and east of Scotland, with an account of their places of growth and properties.* By Alexander Murray, M. D. Part I. Edin. 1836. 8vo.

This work is evidently the result of much pains-taking and labour: and, although it does not exactly correspond in its plan with our ideas of what a Flora ought to be, it were to assume a very unbecoming censoriousness, not to admit its great merits which are certain, while what we deem its faults may lie in our own disputable conceptions. It may be characterized as a faithful Flora of the shires of Forfar, Kincardine, Aberdeen, Banff, Murray, and Nairn, with frequent notices of the rarer plants of Ross, Sutherland, and Caithness. The descriptions of the species are original, and derived from specimens gathered in the district, which is as it ought to be; and to each genus there are some useful remarks appended to facilitate the student's attempts in discriminating nearly allied species,—and not unfrequently a note on the validity of certain among them, which may set the experienced botanist to work again. We find besides, a copious list of habitats, and a detail of the medicinal and economical virtues of the herbs, which occupies a space that, in our opinion, might have been better occupied with their present vulgar usages among the natives of these wild Highlands. It is not in a "Flora" that the mediciner—qualified or quack—will seek his remedies, and we botanists are too healthy a race to care for these things.

We refrain from entering into a minute examination of the book at present, — when completed we may find time to write a longer lecture,—but we must now express the pleasure we have had in perusing the notices which the preface contains of Dr David Skene, a naturalist whose merits have been too long buried in forgetfulness. It seems to us, that it would be erecting a just tribute

to his memory, were Dr Murray to edit the unpublished works of this learned man, and it were strange lukewarmness to departed worth, were the naturalists of the day not forward to encourage such an undertaking. We call Dr Murray's attention to this suggestion, and beg to express our hopes that it may meet the approval of the friends of Dr Skene. Fac-simile extracts from two of the letters of Linnæus to Skene are appended; we would rather have made our selection from the letters of Skene to Linnæus.

There is an appendix to this part of the Northern Flora, 1. containing "notes from the ancients on certain indigenous species," by Mr Adams, surely the most learned of all country surgeons; and 2. "observations on the agricultural properties of native plants, by the Rev. J. Farquharson." The latter, restored to its original state, (for Dr M. has omitted much of the communication) would form an excellent article in the Journal of Agriculture.

Dr Murray is of opinion that the *Veronica hirsuta* is a mere state, not even a good variety of V. officinalis; while he is inclined to believe, that the Highland *Veronica humifusa*, now generally reckoned a variety of V. serpyllifolia, is a good species,—an opinion to which we are not altogether disinclined, for certainly it is, with its large handsome blossoms, very unlike any prostrate variety of the serpyllifolia which we have gathered in the north of England. We have less hesitation in giving our assent to the propriety of keeping *Potamogeton compressa* and *pusilla* distinct; neither the authority of Hooker nor of Arnott can persuade us to forsake the guidance of Smith in this matter, since we have found his observations exact to nature. *Eriophorum pubescens*, not included in this Flora, we can assure our author, is not a rare plant in Sutherland, growing along with the more common E. angustifolium; and our enthusiastic friend Mr Stables can, if our memory does not greatly deceive us, communicate specimens of the former, gathered during an excursion, the memory of which he will oft fondly recall "when time brings on decay." The *Myosotis secunda* of Dr Murray is surely the same with the M. repens of Don, but in the slight dubiety of their identity, some excuse may be found for the imposition of a new name; there can be none allowed for misnaming our Poa trivialis the *P. scabra*,—and it is certain, that an indulgence in such puerilities of nomenclature is a ready means of rendering nugatory an author's authority in higher matters.

"On the whole," to use the words of our correspondent H. C. Watson, than whom no one is better qualified to give an opinion on the subject, "we can recommend the 'Northern Flora' as an useful

addition to our stock of such works, and one that was really needed. To the resident botanist it will of course be acceptable, and the tourist will be supplied, for the first time, with a botanical guide to the north-east of Scotland. Even the distant botanist will feel an interest in the work, from the circumstance of its describing the plants found in the most northern part of Britain, and concerning which there have hitherto existed only scattered notices." Mr Watson mentions that he has a specimen of Eriophorum pubescens from Allangrange in the county of Ross. "Hordeum murinum is stated to be unknown northward of Moray, and in the counties of Aberdeen and Banff. We believe that a locality for this species, near the town of Aberdeen, has been published, though we are unable to refer to it exactly, at the present moment; and another locality for the same species in Sutherland, is mentioned in the "Outlines of the Distribution of British Plants,"—a work which Dr Murray's preface intimates that he has seen."

Bibliographical Notices.

Catalogue of British Plants. Printed for the Botanical Society of Edinburgh, 1836. Edinburgh, Maclachlan and Stewart, Carfrae. London, Longman and Co. Baldwin.

The *Catalogue* published by the Botanical Society is an admirable example of the *multum in parvo*, and, looking to its price, we might add, of the *multum* pro *parvo*. We have here, on one side of a sheet of paper, the fullest list of British plants, both species and varieties, yet published; the authority for every name being added. All the species or varieties, found within sixteen miles of Edinburgh being distinguished by marks indicating the conditions under which they exist, namely, "very common—less common, but of frequent occurrence—abundant in one or two localities—rare—doubtfully native—certainly introduced—others beyond sixteen, but within thirty miles of Edinburgh." This catalogue includes 1636 species and 149 varieties of plants reputed British, and marks 894 species and 18 varieties as appertaining to the tract of country within a radius of thirty miles of Edinburgh. Of these, ninety-one are considered to be introduced species, and forty-three to be doubtful. It is calculated to be useful, not only to local botanists and the members of the society, but to British botanists at large; and the careful and accurate manner in which it has been drawn up, reflects much credit on the individual (or more probably individuals) to

whom the preparation of it has been deputed by the society. On one point, however, we think some censure merited by this individual, if not by the society at large. The signs or marks used for indicating the comparative frequency or exotic origin of the species have been most arbitrarily crossed and changed, in utter disregard of the manner in which they have been heretofore applied by others. The asterisk (*) has been long in use to designate an introduced species, but Professor Henslow, we believe, first applied a series of marks in a definite manner, and he has been since followed by others. We certainly think that the Botanical Society should have paid the usual deference to priority, instead of making capricious changes in the use of signs purely conventional, and which could not have been misapplied in the first instance. Confusion is almost sure to arise from this unnecessary change, and not the slightest benefit can accrue from it as a counterpoise to the evil. About thirty names are introduced into the catalogue, as appertaining to species not recorded in the British Flora. Three or four of these may be British plants, and have claim to be ranked as species. All the rest appear to be mere varieties or introduced plants, or to be identical with species familiar to British botanists under other names. *Carex Buxbaumii, Polygonum maritimum, Alyssum calycinum,* and *Ononis reclinata* appear to have the best claim to exception; yet the two last may have been introduced by human agency, and the second approximates to the maritime variety of *Polygonum aviculare.* The catalogue is well adapted to supply a standard for reference and comparison of lists, and we should be glad to see the whole area of Britain divided into tracts of similar extent, each supplied with its floral catalogue in such a cheap and condensed form. But it must be observed, that the catalogue is to be trusted as authoritative only so far as the plants of Edinburgh are concerned. As a general list of British plants, it includes all that have been *said* to grow in Great Britain and Ireland, and this is a widely different matter from a list of all that really *do* grow there spontaneously. There are two forms of the catalogue; in one, the list of names is printed in long columns on the single side of a large sheet, which can thus be folded up as a post letter; in the other, the sheet is printed in such a manner as to fold up into a fasciculus of sixteen pages.

A History of the rare Species of British Birds, intended as a Supplement to the History of British Birds by the late Thomas Bewick. By T. C. Eyton, Esq. London, 1836. 8vo. Pp. 101. With catalogue arranged, pp. 67. Wood-cuts.

An extract from the prospectus will be the most correct manner of conveying information regarding the intentions of this desirable addition to the work of our most popular ornithologist. "Since the time of the publication of the last edition of the History of British Birds, by the late Thomas Bewick, many birds have been discovered to be inhabitants, or visitants, of the British Isles; and are consequently not figured in his work. To supply this deficiency is the only aim of the author; and, to the accomplishment of which, he trusts he shall be deemed competent, as he possesses nearly a perfect collection of British birds, and has the assistance of some eminent naturalists in his undertaking."

A supplement to the works of Bewick, exhibiting the additions which from time to time have been made to the list of British birds, has been a desideratum which we find well supplied in the little work before us. The wood-cuts are executed in the best manner of the modern wood engraving, but it would be difficult indeed to come up to the feeling of Bewick, his own draftsman and artist. The letter-press is short, but perhaps sufficient for every purpose, gives the authorities for all the species introduced, and generally the collections in which the specimens are now to be found, and concludes with a catalogue arranged under three heads: 1. What the author considers entitled to the rank of "British birds;" 2. "Extinct species;" 3. "The principal among the introduced species." Of the nomenclature, arrangement, and changes which are proposed, we fear, that, like the ornithologists he complains of, the author has also added and changed unnecessarily.

The following remarks occur in looking over the numbers. *Regulus Ignicapillus* has, we believe, been lately taken in the vicinity of Durham. *Linaria canescens* we have always considered to be the F. borealis, Roux; mentioned with doubt in Temm. Manuel, and again under the above name in the 3me part, p. 264; figured in Vieillot's Gallerie; and we believe it will prove identical with the bird represented by Mr Selby as a variety of the lesser redpole, and mentioned L. P. i. p. 320.—See our "Intelligence" of No. I. for a notice of *Macroramphus griseus*, again killed in Britain. *Sterna arctica* is perhaps the most common species in Scotland; it abounds during the breeding season upon all the rocky islands in the Firth of Forth, from Queensferry to the Fern Islands. The most import-

ant bird in the work, on account of its being given as altogether new, is *Turdus Whitei*. It is difficult to give a decided opinion without having seen the specimen, but we think it will prove ultimately to be a missel-thrush in immature or in some variety of plumage. *Turdus varius* may be known in all its states by the deep velvety black of the axillary feathers.*

Herpetologia Mexicana seu Descriptio amphibiorum Novæ Hispaniæ quæ itineribus Comitis de Sack, Ferdinandi Deppe et Ch. Guil. Schiede in Museum Zoologicum Berolinense pervenerunt. Pars prima, Saurorum Species amplectens, adjecto systematis Saurorum prodromo, additisque multis in hunc amphibiorum ordinem observationibus. Edidit Dr Arend. Friedericus Augustus Wiègmann. *Accedunt Tabulæ Lithographicæ Decem, novorum generum typos exhibentes.*—Berolini, 1836.

It is quite unnecessary to say more, than that the execution of the work fully justifies this ample title. The genera in the table are carefully characterized, and the plan is convenient and easily understood, though not so natural in the arrangement of the groups as might be.

The descriptions of the species are full, the plates very accurate, and beautifully coloured.

The work contains the following new genera: *Dracunculus* for some species of *Draco Chamæleopsis*, which scarcely differs from *Corythophanes* of Boie. *Læmanctus*, very like *Polychrus*, but without any pores, and differing in the comparative length of the toes. *Strombilurus*, like *Tropedurus*, but with a keeled back, and larger keeled scales. *Platydactylus*, with slender toes, only dilated at the end.

The plates represent the genera *Heloderma, Læmanctus, Corythæolus, Chamæleopsis, Sceloporus, Phrynosoma, Genhonotus.*

It may be remarked, that *Phyllurus* is rather a sub-genus of *Goniodactylus* than of *Gunynodactylus*, as its toes are compressed and arched, like the typical species of that genus.—J. E. G.

British Fungi, consisting of dried Specimens of the Species described in Vol. V. Part II. of the English Flora; together with such as may hereafter be discovered indigenous to Britain. By the Rev. M. J. Berkeley, M. A. Lond. 1836. 4to. Fasc. i., ii.

This work has nothing to recommend it but its utility; it is nei-

* The loan of this bird, for a figure in the new series of "Ornithological Illustrations," will be esteemed a favour.

ther beautiful nor ornamental, nor are the specimens selected and disposed with the nicety and neatness which might have been wished for by some finical collectors. Notwithstanding this, we are told that the sale of the work has already exceeded the anticipations of its respected author, a fact which is cheering, since it indicates the existence of a greater number of scientific botanists in this country than we were disposed to reckon on, for assuredly Mr Berkeley will number no mere amateur among his subscribers. We cordially recommend the work, which is, indeed, indispensable to every one engaged in the critical study of British Fungi. Each fasciculus contains sixty specimens, pasted on separate pieces of paper, so that they may be arranged hereafter in accordance with the "system" which the purchaser most approves of.

Transactions and Periodicals.—*British.*

The Edinburgh New Philosophical Journal. Conducted by Professor Jameson. July to October 1836. Edinburgh. A. & C. Black. (Continued from p. 286.)

I. *Zoology.*

An unimportant Number to the Zoologist or Botanist.——W. V. Thompson, Esq., "Memoir on the metamorphosis of the Macrourae or long-tailed crustacea, exemplified in the prawn (Palemon serratus.)" A short paper, stating that changes similar to what the author described in the Brachyuræ, took place in the Macrouræ. In Palemon, the larva, although different from that of the crabs, is nevertheless a Shisopoda, generally of a totally different aspect from the parent animal, and provided at first with a very limited number of cleft members, commonly two or three pairs, perfectly analogous to those of the Zoe. These larvæ also appear to undergo a successive developement, probably embracing several stages. A plate is given.——Robert Jameson, Esq. Assistant Surgeon, 10th Regiment foot, "Notes on the Natural History and Statistics of the Island of Cerigo and its dependencies."—Devoted to the physical appearances of the island, its mineralogy and agriculture.

II. *Botany.*

Dr Graham, "Notes regarding some of the plants observed during the last year in excursions from Edinburgh."

The Magazine of Natural History. Conducted by J. C. Loudon. Vol. ix. Nos. for Sept. Oct. (Continued from p. 288.)

I. Zoology.

Taylor's Notes on natural objects observed while staying in Cuba, p. 449.——Notices of modes of capturing fishes, p. 457.——Tatem on the elephant's mode of progression, p. 459.——Waterton on the habits of the Windhover

hawk, p. 460.——Couch on the characteristics of a kind of Trigla hitherto confounded with the T. Blochii, p. 463. The fish here described agrees in all its essential characters with the Trigla noticed by Cuvier (Poissons, Vol. iv. p. 67,) under the name of T. Cuculus, *Bl.*; from whose description it differs only in the absence of a dark spot on the first dorsal; a circumstance which, it is remarked by that author, is liable to variation. But it is distinguished from Bloch's gurnard of Mr Yarrell (*Br. F.* p. 50,) in a variety of particulars, of which the chief are, the very great difference of size, the latter "rarely exceeding 1 foot in length, and seldom above 9 or 10 inches;" *—"the whole body rough," whereas this fish is not rougher over the body than the tub-fish is, "the lateral line more strongly serrated than in the grey gurnard," whilst in the fish now under consideration, this part is but faintly, though distinctly, roughened: "Bloch's gurnard" is also distinguished, not only from this, but every other British species, by having the first dorsal ray the longest; a circumstance not noticed by Cuvier in his description, which is very minute, and especially instituted for the purpose of distinguishing it from the neighbouring species; between which and it that circumstance would have formed the most decided character. The air-bladder, the shape and size of which offer good marks of distinction in the different species of Triglæ, is, in this species, 4 inches in length, and 6 inches in circumference, divided anteriorly into two lobes, both conical, but one much larger than the other."——A continuation of Mr Templeton's catalogue of the species of Rayed animals found in Ireland, p. 466.——Johnston's illustrations in British Zoology, being figures and descriptions of Cuvieria Phantapus, p. 472, and of Asterias papposa, p. 474.——Blyth's further remarks on the affinities of the feathered race, and upon the nature of specific distinctions, p. 505.——Remarks on Wood's British Song Birds, p. 515.——Salmon's Notice of the arrival of twenty-nine migratory birds in the neighbourhood of Thetford, Norfolk; together with some of the scarcer species that have been met with during the years 1834, 1835, and 1836, p. 520.——Westwood on a congregation of moths found in the interior of a tree of the False Acacia, p. 528.

II. Botany.

Pamplin on the discovery in Britain of what is supposed to be Gymnadenia odoratissima, p. 475.——Henslow on the production of sugar-candy in the flowers of Rhododendron ponticum; and on the germination of the seeds of an Acacia by boiling them variously, p. 476.

Besides these papers there are numerous short notices, of more or less interest, illustrating the habits of animals, and their instincts.

Companion to Botanical Magazine. By Sir W. J. Hooker, Professor of Bot. in the Un. of Glasgow. Parts xv. xvi. 8vo. Curtis, London, 1836. (Continued from p. 289.)

The account of the esculent plants of Van Diemen's Land, (from the Van Diemen Almanac) is continued from last number. The more remarkable indigenous plants are now noticed. Several of the *acaciæ* produce a useful gum

* The length of the new species is 26 inches; the girth, 15½.

employed for various purposes.——Acæna sanguisorba or native burnet, with the kangaroo grass, much deteriorate the Van Diemen wool. The thorns of the one, and awny seeds of the other get into the fleece, and cannot be removed by washing; it is recommended, if possible, to have the sheep shearing season over before the seeds of these plants reach maturity.——Arundo phragmites is apparently the same with the European plant; it is abundant, and is useful for thatching. The panicles dye wool green, and the root is said to be useful in liver complaints. Will it not possess the same qualities here?——Banksia australis, " when planted in rows and well clipped, forms a stout and impervious hedge, not surpassed by the hawthorn or holly."——Dacrydium? cupressinum or Huan pine, must be a noble tree, " A height of one hundred feet, and a circumference of thirty, are generally attained by this splendid pyramidal tree." ——The Eucalypti are most useful, and are also numerous in species; easily felled and wrought when green, they become hard as oak when dry, and are used for economical purposes. The leaves also exude a sort of " Manna," greedily devoured by birds and insects, and picked up and eaten by the aborigines. A few of the more common or remarkable plants are also noticed, and the paper will be found worthy of perusal either by the popular or scientific reader.——Illustrations of Indian Botany, by Dr Wight and G. A. W. Arnot, Esq. continued, with a figure of Sesuvium repens.——" Botanical information," announces the publication of 2d Fasciculus of Berkeley's Fungi, (See Bibliog. notices, p. 401.) The 3d will be published in March 1st 1837.——Some interesting notes relative to the botany and horticulture of some of the German towns, follow extracts from the correspondence of a friend: and the number is concluded with the commencement of " a brief Memoir of the Life of Mr David Douglas, with extracts from his letters, accompanied by a portrait," which occupies also the whole of No. xvi. We shall wait for its completion, and shall then give some extracts from the adventures of one who has introduced so many beautiful and hardy plants to the gardens of Britain.

Transactions and Periodicals—*Foreign.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin. Aus dem Jahre 1834.—Berlin, 1836.

Vergleichende Anatomie der Myxinoiden, der Cyclostomen mit durchbohrtem gaumen. Von Herrn Müller.—*Comparative Anatomy of the Myxinoideæ, &c.*—The author begins by stating the great advantages which zoology has of late years derived from the habit which has arisen of either pursuing the history of some particular organ through each branch of the animal kingdom, or of giving a very accurate anatomical description of some individual, which may serve as a basis for farther comparative observation. The works already published upon the anatomy of the tortoises, the Ornithorynchus, the Cossus of Lyonnet, the Cockchaffer, the Nautilus, &c. are admirable instances of accurate detail. But it is of still more importance that we should be well acquainted with the structure of those animals which stand as it were upon the boundary of some other class, and partake at once of the characters of both. On this account, a knowledge of the anatomy of the Ornithorynchus, and of the Echidna, throws light on the study

of the Mammalia; that of the Proteæ and the Cæcilia, on the Amphibia; that of the Cyclostomata, on the fishes; and that of the Lerneæ on the Crustacea. The Cyclostomata are, however, doubly interesting, as they at once occupy the extreme limits of the fishes, and form the link between the vertebrate and invertebrate animals. So great uncertainty has hitherto prevailed with regard to them, that they have been placed in four different classes by naturalists, viz. amongst the Pisces, the Amphibia, the Mollusca, and the Vermes. The Myxine glutinosa was first noticed upon the coasts of Greenland and Norway by Kalm, and was described by him as a species of Lamprey. Linné gave it the name which it still bears, but classed it amongst the Vermes. Modeer placed it amongst the Amphibia. Retzius thought it ought to be placed in the same class as Petromyzon, agreeing with Linné in opposition to Camper, that it comes nearer to Vermes than to Pisces, and that it might without difficulty be separated from the latter. F. O. Müller classed it with the Mollusca, probably on account of the presence of tentacula. In the edition of the Fauna Suecica by Retzius, the Myxine is placed amongst the Pisces. The object of the present elaborate treatise is to obviate these uncertainties, and from a careful anatomical examination, to assign to it its true station in the animal kingdom, as well as to corect some errors and oversights which appear in the remarks of Bloch, Dumeril, Sir E. Home, and other writers upon the subject. Before proceeding to anatomical details, the author gives a classification of the cartilaginous fishes, and particularly of the Cyclostomata, in which the Myxine is placed in conformity to its internal structure. He divides the cartilaginous fishes into four orders, and with regard to the sharks follows Cuvier's arrangement of the genera, though he thinks that, judging from the varieties found in the Mediterranean alone, that great naturalist has not made them sufficiently numerous.

CHONDROPTERYGIA. Skeleton cartilaginous; cranium without sutures.

I. Order. BRANCHIOSTEGA.

1. Family, CATAPHRACTA — Cartilage of the cranium, and skin of the trunk covered at intervals with cartilaginous tubercles.

Sturiones. Genus 1. Sturio—with Brandt's subgenera, Huso, Sturio, Sterleta, Helops.

2. Fam. NUDA—Body without tubercles.

Spatulariæ. Genus. 2. Spatularia with the subgenera, Polyodon, Lacep. and Planirostra, Rafinesque, Icth. Ohiensis.

II. Order. HOLOCEPHALA.

Genus 1. Chimæra.

2. Callorynchus.

III. Order. PLAGIOSTOMATA.

1. Family. SQUALI. The branchial apertures not fixed to the head.

Genus 1. Squalus, with Cuvier's subgen. Scyllium, Carcharias, Lamna Galeus, Mustelus, Notidanus, Selache, Cestracion, Spinax, Centrina, Scymnus. *

2. Zygaena, Cuv.

3. Squatina. Dum.

4. Pristis. Lath.

* The toothless Sharks, Aodon, Lacep., Massassa and Kumal, Forsk. are still doubtful.

2. Family, Ralæ. The branchial apertures fixed to the head.
   Gen. 5. Rhinobatus, Schn. with the subgen. Rhinobatus and Rhina, (the latter doubtful.)
   6. Torpedo, with the subgen. Torpedo and Narcine, Henle.
   7. Raia. Subgen. Raia, Trygon, and Anacanthus.
   8. Propterygia, Otto.
   9. Myliobates. Subgen. Myliobates, Dum. and Rhinoptera, Khul.
   10. Cephaloptera, Dum. with subgen. Cephaloptera, and one other, not named.

IV. Order Cyclostomata.

1. Family, Hyperoartia. With the nasal aperture closed, and the palate entirely covered with skin
   Genus. 1. Petromyzon.
   2. Ammocœtes.
2. Family, Hyperotreta. With the palate perforated.
   Genus 3. Myxine.
   4. Bdellostoma, Nob.

The author then proceeds to describe the characteristic points in his divisions of this fourth order of Cartilaginous fishes, (the Cyclostomata,) and the various new species which he has discovered.

1. Family, Cyclostomata Hyperoartia.
   a. with the teeth visible, Dentata. Genus, Petromyzon.
   Species, murinus, argenteus, fluviatilis, planeri.
   b. without teeth, Edentata.
   Gen. Ammocœtes.
   ——————branchialis.
   ——————ruber, (doubtful Lac.)
2. Family, Hyperotreta. With the palate perforated. Myxinoidea.
   a. with connected external spiracula branchialia.
   Myxine, (Gastrobranchus, Bloch.)
   ————glutinosa.
   b. with separated external spiracula branchialia.
   Bdellostoma.
   Hexatrema (spec. nov. Nob.) Table bay.
   Heterotrema (spec. nov. Nob.) Table bay.
   Heptatrema Nob. South sea.
   Forsteri, Nob. (Petromyzon cirrhatus, Bloch, Forster.) New Zealand.
   Doubtful species. Dombeyi.

The stability of this arrangement of the species depends upon the supposition that the number of the branchial openings and of the teeth upon the tongue remain constant, which future observations must determine. The teeth on the tongue of Myxine glutinosa are very constant. The habits of the last mentioned species are very little known. It is said by Kalm to attach itself to the body of the stock-fish, and to extract nourishment from it. By other writers it is said to penetrate into the intestines of different species of fish.

The Bdellostoma Forsteri is found hanging to the fragments of fish which are placed in nets as bait. Forster says that it frequents rocky places, near the sea shore. While the Myxine frequents the Northern seas, the Bdellosto-

mata are found at the Cape of Good Hope, in the South seas, on the coasts of New Zealand, and of Chili Many of the other Cyclostomata have a still wider range, as well as the peculiarity of inhabiting both fresh and salt water, as the Ammocœtes, Petromyzon fluviatilis, and P. planeri, which occur in the rivers of Europe; the P. marinus, which abounds in all the European seas, has also been taken in fresh water. They have been found in Japan, Tranquebar, and South America. Before he proceeds to the anatomical details, the author gives a general description of the genera Myxine and Bdellostoma, which it is unnecessary to insert. The species belonging to the latter genus are furnished with eyes. The Myxine glutinosa, on the contrary, is totally blind, and forms the only example hitherto known of a vertebrate animal, not possessed of any visual organs. Those animals which are generally called blind are always provided with organs which, at least, enable them to distinguish the light, though the eye itself is covered by a membrane, as Spalax typhlus, Proteus anguinus, Silurus cæcutiens, Acontias cæcus, &c. There are many examples amongst the invertebrata of total blindness, even amongst classes, the generality of which possess the power of vision. Then follows a most accurate description of the osteology of the Myxinoidea, succeeded by a close comparison of their different organs, with the corresponding parts in the cartilaginous, as well as other fishes, and the results of a chemical examination of the bones of each. On exposing a portion of the spinal column of the Squalus Cornubicus to a white heat till all the animal matter was consumed there remained in one instance 41,55%, in another, 42,068%, of ashes. These contained a very large proportion of phosphate of lime, a portion of sulphate of lime, and evident traces of fluoric acid. Carbonic acid could also be detected. The cartilage of this class of fishes he divides, according to its internal structure, into four classes. The first is called the hyaline cartilage, and is nearly transparent. It is not found in Petromyzon, but abounds in the sturgeons and chimæræ. The second is the tubercular calcareous cartilage, and is most abundant in the Plagiostomata. The third is the cellular cartilage, which is found in the Bdellostomata, and the fourth is termed the ossified cartilage, forming the hardest bones of many of the sharks and rays. On calcining the tubercular cartilage of a large ray, there remained an inconsiderable residuum, which consisted chiefly of phosphate of lime. Fluoric acid was also perceptible, as well as carbonic acid, and sulphur; but it appeared doubtful whether the latter was in the metallic form or as sulphuric acid. A portion of hyaline cartilage, carefully prepared, left a very trifling residuum, which also gave evidence of containing sulphur and phosphorus, combined with lime, but not so as to be separable. An analysis of the bones and cartilage of Squalus peregrinus, conducted by Chevreul, and apparently with greater accuracy than those made by the author, is also given.* We have not room for the details which follow of the comparison between the chorda dorsalis of the Cyclostomata, and that of the higher vertebrata; but the conclusion the author arrives at is, that the spinal column of the Cyclostomata retains the same form and condition as that which we find in the embryos of the higher orders of animals, during the first days of their conception. The following are the gradations which the spinal column undergoes in its structure, ascending from the lower to the higher animals.

* Vide Ann. du Musée d'Hist. Nat. Tom. xviii.

1. A filamentous cartilaginous tube filled with gelatinous matter, and surrounded with a fibrous skin, the upper side of which forms a second tube, resting on the lower, and which is occupied by the spinal marrow. No rudiments of bone or divisions into joints. The Myxinoidea and Ammocœtes.

2. The same structure as the former, except that on the upper part of the tube there are some cartilaginous processes. Petromyzon.

3. The same structure as the last, with the addition of two cartilaginous basilary processes placed on the under side of the spinal column. Accipenser, Polyodon, Chimæra.

4. The gelatinous tube remains constant, and portions of a fluid gelatinous substance occur between the conical facets of the spine, which articulate with one another. The joints of the spine developed. Fish, Proteæ, Menopome, Cæcilia, and the young of frogs and salamanders amongst the naked Amphibia. (Fœtus of the higher animals at one period of their growth?)

5. The conical facets of the joints of the spine, and the gelatinous matter between them remain stationary, and the spine is either simply divided into joints, (Amphibia, birds during their growth,) or has ligamenta intervertebralia between them. Mammalia, Man.

The author then proceeds to compare the cranium of the Myxine with that of the Petromyzon, and in the following chapter, he compares the cranium of each with the structure of their respective spinal columns, and with the skulls of the Embryos of the higher animals. He describes the gradual development of the skull as we ascend from the lower classes of vertebrata, and considers the crania of Ammocœtes and Myxine to be analogous to those of the fœtus of the higher animals.

He next describes the labial cartilage, and remarks upon the great variety in the formation of the lips in this class of fishes, as well as the different number of lips possessed by various genera, and the uncertainty they have caused amongst authors. The palateal bones and those of the jaws are next described, beginning with the Plagiostomata, and proceeding through the different families down to the Cyclostomata. He then continues his account of the comparative anatomy of the remaining bones of the head, except those of the tongue and the branchiæ, which in the generality of the cartilaginous fishes, as those of the Myxinoidea, vary too much from them to admit of comparison. Their structure, moreover, has already been well described by Rathke and Henle. Having thus concluded the osteology of the Cyclostomata, the author proceeds to describe their Myology, and follows the same plan as before, in first giving the details of their muscular system, and then their comparative anatomy. The descriptions are illustrated by very accurate plates engraved from the author's drawings, without which it is impossible to give an intelligible notion of the various structure in a mere analysis like the present. The muscles of the trunk are first explained, and then those attached to the various bones of the head, and lastly, those of the tongue, which in the Myxinoidea have no resemblance to those of other animals. The organs of breathing in the Bdellostomata and the Myxine glutinosa are then detailed, and the various muscles of the different genera compared with one another; and lastly those of the trunk, with the corresponding ones in the higher orders of animals. The remainder of the treatise is occupied by a curious dissertation on the analogy of the muscles in different parts of the human body, and on the variations observable in different individuals, as well as in animals, such

as the occurrence of supernumerary bones, muscles, &c. This is done with a view of establishing data for the analogy, or what may be called the philosophy of the muscular system, which has hitherto been much neglected. Great praise is due to the author of this valuable treatise for the diligence and accuracy displayed in his researches, and for the clearness with which the details are explained. The light which he has thrown upon the history of the Cyclostomous fishes promises to be of great utility, and the scientific manner in which the inquiry is conducted may serve as a model to future writers on comparative anatomy.

Das Leutchen des Meeres. Von Herrn Ehrenberg.—This paper contains the result of numerous observations and experiments made by Ehrenberg upon marine luminous substances, between the years 1820 and 1834. Before entering upon the subject, he gives an historical account of the notices of luminous phenomena which are to be found scattered through the works of various authors, from the days of Aristotle to the present time. The first detailed account of marine light is given by Don Juan de Castro in 1541, in his Journal of a Voyage in the Red Sea. Between that period and 1716, so many navigators had described similar appearances, that in the latter year the Academy of Bordeaux offered a prize for the best explanation of them, and the subject, so far from being set at rest, still continues to excite curiosity. Ehrenberg mentions above 430 authors who have written upon the various kinds of light, both terrestrial and marine, and has drawn up very interesting tables of the various substances, animal as well as vegetable, from which light has been emitted, according to all these writers, forming a condensed history of the whole subject.

The author's first observations were made in 1820, at Alexandria, in conjunction with Dr Hemprich. He there collected a quantity of luminous sea water, which contained quantities of minute shapeless gelatinous bodies, which shone like small sparks when the water was stirred. At Dongala on the Nile, in 1822, he was much struck by the brilliant phosphorescence emitted from the whole skeleton of Heterotis Nilotica, and which he never afterwards saw equalled in any other species either of fresh or salt water fish which he obtained, though he thinks that the arsenical soap which he was obliged to apply in that hot climate without delay, in the preparation of specimens, may have interfered with it. Perhaps the Heterotis is the Dilychnos of Strabo which inhabited the Nile, and whose eyes emitted a singularly brilliant light after death. The author remained stationary at Tor on the Red Sea, for five months, and was frequently engaged in examining the sea water, which was found to be very full of small slimy particles, without any determinate form, often having the edges jagged, and which emitted light on stirring the water in which they were found. They covered the marine plants, corals, &c. which consequently appeared luminous; every stroke of the oar caused them to sparkle, but he was never able to detect any organization in them, and he never could satisfy himself that any of the microscopic animals which he found with them in the water gave out light. They did not unite and form large slimy masses, but were dispersed about in small flakes. Decaying substances emitted no phosphoric light on the shores of the Red Sea, probably owing to the rapidity of their decomposition. The larger species of medusa are rarely met with. The Arabs call them all Kandil al Bahr, or sea lanterns, and it seems that those medusæ which are generally accounted luminous, only emit light at stated periods, as the author had specimens

of Andromeda. Cephæa, and Medusa aurita in particular, numberless times in his possession, and watched them both by day and night, but never once saw any light issue from them. In July 1823, he observed near the shore at Moileh, shoals of Clupea erythræa, which apparently emitted a brilliant light, but he supposes that they only stirred up the water, and that the light proceeded in reality from the before-mentioned luminous bodies with which it abounded. The oars caused at intervals a similar appearance, which tended to confirm his opinion.

During his stay in Arabia, Ehrenberg observed that as long as infusoria were not removed from their native element, or from the substance to which they were attached, they could be transported alive to a considerable distance. Thus he carried a great number of them in a tin box, together with the conferva upon which they were found, from Tor, on the Red Sea, three days journey towards Mount Sinai, exposed to the burning heat of that climate, without their suffering any injury. As long as the confervæ remained green, they retained their vitality. Acting upon this knowledge, in 1830, he caused some bottles of sea water to be sent from Kiel, on the East Sea, to Berlin, containing luminous matter, and found that, on shaking one of them, sparks were clearly visible. The contents of another bottle failed to emit any. He then poured some of the water from the former bottle into a glass, and dropped a little sulphuric acid into it, when several bright flashes of light were seen. He found that the bottle contained several species of living Cyclops, but that they were not luminous. He also found a specimen of Synchaeta Baltica, which Michaelis had considered as luminous, but it did not shew any signs of being so. The really luminous animals were found at the bottom of the bottle. On taking one up in a drop of water on the point of a pen, and adding a portion of sulphuric acid, it emitted a spark, and died directly after. He arrived at the conclusion, that all the light which was emitted from the Kiel water proceeded from many individuals of one species, which he named Polynoe fulgurans, and of which he gives a highly magnified representation. In 1832, he obtained more water from Kiel, when these experiments were many times repeated, and always with the same success; by taking up a drop containing a specimen, and touching it with the acid, the luminous properties of various new species were discovered. In no instance, however, could he perceive any light issue from Synchaeta Baltica, and he accounts for the variation between his own experiments, and those of Michaelis, by supposing that the luminous properties depend upon the fruitful or unfruitful state of the individual at the time. The specimens figured by Michaelis are represented as carrying eggs with them, and as having a succession of them in the ovarium. Those examined by Ehrenberg had the ovarium undeveloped. Not one of the numerous Entomostraca, and especially the genus Cyclops, with which the water was filled, and which greatly surpassed the other infusoria in size, emitted any light. In 1833 the author was at Droebak, near Christiania, in Norway, and obtained several species of luminous animals, and some new ones amongst them, but none were infusoria. The light given out by Oceania microscopica is much clearer, brighter, and more white than the yellow sparks of the infusoria. He was convinced that the light of Cydippe pileus proceeded from the centre where the two ovaria are situated. In 1834 he tried several experiments upon Medusa aurita at Wismar. The sea water in August ranged from 11 to 4° Reaum.

He placed specimens in spring water, in brandy, in sulphuric acid; exposed

them to heat; he punctured, cut, and tore them, but in spite of all his efforts, never could discern the smallest spark of light. The ovaria of some were full, and of others undeveloped. The same remarks apply to the undoubted specimens of Medusa aurita which he obtained in the Red Sea. Humboldt, in his voyage to the Brazils in 1814, caught several specimens off Teneriffe, which were peculiarly luminous. On being laid on a tin plate, they emitted light when it was struck. The same phenomenon occurred the moment that the wires of a galvanic battery were joined. Ehrenberg therefore supposes, from the totally different results which he always obtained, that what is called the Medusa aurita of the Atlantic must be a very nearly allied species to that found in the East Sea, and the Red Sea, though hitherto called by the same name. After a violent storm at Heligoland in 1835, numbers of Medusa was thrown ashore, and amongst others, Cyanea capillata, Chrysaora isoscela, Cyanea Lamarckii, and a small new species, to which Ehrenberg gave the name of Cyanea Heligolandia. None of them emitted any light, but thinking that a difference of temperature might have occasioned the disagreement of his own observations with those of Humboldt, they were placed in warm water, but without effect. No infusoria were found in the luminous sea water at Heligoland, but quantities of morsels of gelatinous matter, often torn and ragged, which emitted light, and small gelatinous globules, with jagged edges, occurred similar to those before described, which he obtained in the Red Sea. They all emitted similar sparks, on pouring a portion of brandy, spring water, or hot sea water upon them. They were evidently alive, swam slowly, and amongst them he easily detected numbers of Medusa or Noctiluca scintillans. On shaking the glass containing them a few sparkled, but not all. During his stay at Heligoland, the author often observed, as it were, chains of luminous matter floating about in the sea, some of which, with some difficulty, he succeeded in obtaining. He then proceeded immediately to his house, and examined them without delay. They proved to be masses of luminous Medusa, detached and torn by the violence of the sea, but he found that they continued to emit light, only as long as they retained vitality. Some of these fragments will live for a week, while others die, and are decomposed in a very short time. He has no doubt that the difference of opinion which exists on this branch of the subject has arisen from collectors having delayed to examine such luminous water, till the morning after it was taken, when the torn particles may be already dead, and incapable of emitting any other light than what proceeds from decaying fish, &c. The sea animal which gives out the brightest light of all is the Nereis cirrigera, one of the Annellides. They live together in large masses, in branching sea-weed, and when portions of it are thrown ashore they continue to live, and shine with great brilliancy for many days. It is difficult, from the momentary nature of the spark given out by the Medusa and infusoria, to perceive in what way the light is generated. In the Photocharis, it is very visible. On each side of its feet, it is furnished with two fleshy threads, the upper one longer than the other, and not so thick but strongly resembling each other in their internal structure: a circulation of globules of blood is perceptible in each. The light always proceeds from these cirrhi, and particularly from the under or thicker one, which lies between the rough tubercles of the foot, and the upper one. A few detached sparks first appear on each cirrhus, which gradually increase till they are both illuminated. They then proceed over the back, till the whole animal shines with a greenish

yellow light. There certainly is some analogy between this light and electricity, and it is remarkable that the Photocharis is covered with a glutinous slime, which retains its luminous property for a few seconds, after it is detached from the animal. Having closely examined twelve species of luminous animals, the author comes to the conclusion, that the emission of light is an act dependent on their vitality, and which can be repressed or exerted at intervals. Spallanzani and others have asserted that parts of Medusa continue luminous after death, but Ehrenberg accounts for this by supposing that, when examined, they were not really dead. He has often taken up Medusæ that had lain for a long time on the sea shore, exposed to the sun, and returned them to the sea, and, after some time they have recovered, and shewn all the usual signs of vitality. He communicated the results of a farther examination of the structure of Medusæ, (made in 1834) to the Academy, in 1835, but which are not yet printed.

This volume also contains a paper by the same illustrious naturalist, upon the Structure of the Vital Organs, both of Man, and of various Animals. It is illustrated by several plates, containing microscopic representations of these parts, in the human body, and in some of each class of vertebrate and invertebrate animals. He first describes the microscope by means of which the investigation was carried on, and then gives in detail the structure of the brain, the spinal marrow, various nerves, ganglions, and sympathetic nerves, and lastly, takes a critical view of the observations of other writers upon the same subject. It is unnecessary to enter into the details of this paper, as most of them have been for some time before the public. They were read to the Academy in 1833, and were published in Poggendorff's Annalen der Physik, Vol. xxviii. 1833, and Vol. xxxi. 1834.

Uber den Bau der Farrnkräuter (on the Structure of Ferns.) Von Herrn Link. —Under the general term Fern the author includes the plants belonging to the following three divisions: 1st, The Epiphyllospermae, or those whose seeds are attached to the back of the leaf, including the Polypodiaceae, Hymenophylleae, Osmundaceae, Gleicheniaceae, Marattiaceae, and Ophioglosseae. The 2d division contains the Lycopodiaceae, and Salviniaceæ, in which the seeds are separated from the leaves. The 3d division contains the Equisetaceae. The object of the paper is to describe the internal structure of the stems of these classes, and the author begins with those of the Polypodiaceae, as a type of the first division. They are divided into five classes, Caudex caulescens, C. stolonescens, C. tuberascens, C. arborescens, and C. frutescens. He enumerates several peculiarities belonging to this tribe of plants, which are illustrated by two plates of sections, and concludes by mentioning several statements, made by writers on botany, Mohl, Meyer, Lindley, Cotta, &c. with which his own observations do not accord.

The paper was read to the Academy in January 1834.

Annales des Sciences Naturelles. Zoologie, MM. Audouin et Milne-Edwards. *Botanique,* MM. Ad. Brongniart et Guillemin. Avril 1836. (Continued from p. 292.)

I. *Zoology.*

In this Number, Dujardin continues his interesting "*Recherches sur les o-*

ganismes inferieurs." He begins with a defence of the accuracy of his former, and a detail of some new observations, which confirm the opinion he entertains, that there is no such complex digestive apparatus in those infusory animalcules, as Ehrenberg has described,—the presumed stomachs and intestines being merely irregular, empty spaces *(vacuoles)* produced by the penetration of the nutritive matters, or by partial dissolutions *(diffluence)* of the homogeneous body. He then proceeds to describe some new forms of Infusoria which, like the Rhizopodes, shoot out from a fixed portion of the body a certain number of long contractile filaments of extreme tenuity, that are subservient to locomotion. He next discusses the nature of the tail-like filament with which many infusory animalcules are furnished, and which, he says, is an organ of locomotion, and not a proboscis, as Ehrenberg was induced to conclude from some observations he had made on the Peridiniees and Cryptomonadines. Dujardin admits, that, as it is homogeneous like the body, and deprived of an epithelium, it may be capable of absorbing from its surface nutritive matters, but that it has not the character or use of a proboscis, he is certain.——The continuation of Hitchcock's "*Description d'empreintes de pieds d'Oiseaux dans le Grès rouge du Massachusets.*"——*Analyse des travaux anatomiques, physiologiques et zoologiques présentés à l'Academie des Sciences pendant les mois de Mars et d'Avril* 1836.—One or two of the notices in this section will be found among our zoological intelligence;—we can only specify here Jacquemin's letters on the respiration of birds; and on the order of the disposition of the feathers on the body of a bird; Duvernoy on the tongue of the *Cameleon;* Geoffroy Saint-Hilaire on the "embryo of Syra," viz. a fœtus which was vomited by a child of the town of Syra, in 1834, and which has been discussed with an interest which the singularity of the occurrence may well excuse: as a *fact*, it cannot be registered in science, since many doubts hang over the real nature of the substance vomited.——*Memoire sur la famille des Béroides, par* R. P. Lesson. In his preliminary paragraphs, the author collects together what has been ascertained relative to the structure and physiology of this interesting family, and then proceeds to divide it into tribes and genera, characterized with neatness and precision. Under each genus, the species are indicated, and shortly described in the usual manner of systematists. The attempt here made to illustrate the *Beroideæ* is unquestionably an able one, but our knowledge of the species is evidently too limited as yet, to allow us to regard any classification, as other than a convenient table for future study. The author has overlooked Professor Grant's Essay on the Nervous System of Beroë pileus, and on the structure of its cilia, in the Trans. of the Zool. Soc. Vol. i. p. 9.

II. *Botany.*

Memoire sur les Myrsinees, les Sapotees et les embryons paralleles au plan de l'ombilic, par Auguste de Saint-Hilaire.——*Memoire sur la distribution et de mouvement des fluides dans les plantes, par* M. Ch. Girou *de* Buzareingues. A very important contribution to vegetable physiology.——*Observations sur les Saxifraga stellaris et Clusii, par* P. Duchartre, who seems to have proved that the two species are merely variations of the same plant.——*Notice sur quelques Cryptogames nouvelles des environs de Bahia (Brésil), par* J. E. Duby.

INTELLIGENCE.

ZOOLOGICAL.

The Leeches and Reptiles of Chili.—It is a remarkable fact that the leeches of Chili are all terrestrial, living in the woods, and never in water. M. Gay assures us that he could not make a botanical excursion without having his legs bitten by these blood-suckers. They crawl upon plants, along trunks of trees, and ascend shrubs, but never approach marshes or rivers; the only one which M. Gay accidentally discovered in these latter habitats is a very small kind of Branchiobolelle, which has the singular habit of living in the pulmonary cavity of the Auricula Dombeii. M. Gay had previously discovered, in the environs of Santiago, another leech of the same genus which lives under the branchiæ of a species of lobster. (The leeches of Chili, in their sylvan manners, resemble the leeches of Ceylon.)

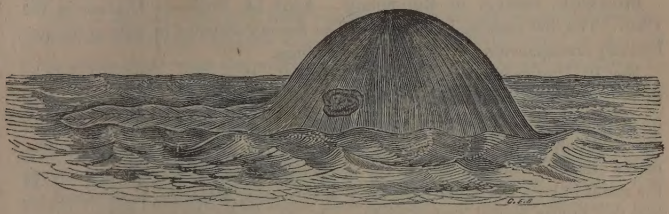
A fact not less interesting is this; in these western regions the reptiles have a tendency to become viviparous. The greater number of those which M. Gay dissected afforded him proofs of this assertion. Not only the harmless snake of Valdivia brings forth living young, but likewise all the pretty Iguanians allied to the genus Leposoma of Spix, and which, from the beauty of their colours, M. Gay provisionally calls Chrysosaurus. Even those species which are oviparous at Santiago are here viviparous. The Batracians furnish some examples of the same fact, although in general they are all oviparous. However, a genus allied to the Rhinella of Fitzinger, consisting of several agreeably coloured species, is constantly viviparous, and consequently adds to the proofs of a fact the more remarkable that all the examples of it are found collected within a radius of two or three leagues only.—*Ann. des Sciences Nat. Avril* 1836, p. 224.

Spirula Peronii.—It is a rare thing to find this common shell with its animal, a fact which, according to MM. Robert and Leclenchet, is in some measure explained by their having discovered that it is the prey and common food of the Physaliæ, which swarm in the same equitorial seas. The figures hitherto published of the Spirula are incorrect; it is a cephalopode which approaches remarkably in form to the shelless Loligo sepiola, having the shell almost entirely imbedded in the posterior part of the body, where there are two natatory expansions of the cloak. The eye is proportionally very large, and without a lid.—*Ann. des Sciences Nat. Avril* 1836, p. 233 and 226.

Huge Marine Animal.—Upon the 22d of June 1834, in latitude 46° 57′, longitude 58° 39′, Captain Neill of the ship Robertson of Greenock, then upon a voyage from Montreal to Greenock, saw the head and snout of a great fish or sea-monster, of which the accompanying sketch or drawing was at the time

made. It was first observed about 9° 15′ A. M., on the weather-bow, about four points; and it then appeared like a large vessel lying on her beam ends.

The Robertson was hauled up so as to near it; and running at the rate of eight knots an hour, she at 12 noon got abreast of it, distant about a mile to leeward. On observation at this time it was discovered to be the head and snout of a great fish swimming to windward; and although it was tried to get closer to it, this could not be done, as the fish, without much apparent exertion, kept swimming as fast as the vessel sailed.



Immediately above the water its eye was seen like a large deep dark hole. That part of the head which was above the water measured about 12 feet, and its breadth or width 25 feet. The snout or trunk was about 50 long; and the sea would ripple over one part, leaving other parts of it quite dry and uncovered. The colour of the parts seen was green, with a light and dark shade; and the skin was ribbed, as represented in the sketch.

Scolopax Major.—A fine specimen of *S. major*, (Great or solitary Snipe), was shot on the 8th of September, by Mr Selby, upon the moor near Twizell House. It was in perfect plumage, and very fat, its weight six ounces. Its flight was observed to be different from that of the common snipe (*S. gallinago*), and somewhat resembled that of the woodcock. It uttered no cry when flushed.—P. J. S.

Northumbrian Noctuadæ.—Among the various nocturnal Lepidoptera, taken this year at Twizell House, Northumberland, are the following, considered of rare occurrence, or which have only been met with in distant localities. *Deilephila elpenor, D. porcellus, Hepialus velleda, Notodonta dromedarius, Leiocampa dictæa, Demas coryli, Nemeophila plantaginis, Triphæna fimbria, Cerigo texta, Lytæa umbrosa, Agrotis valligera, A. suffusa, A. sagittifera, Orthosia litura, Caradrina glareosa, Calocampa exoleta, Hadena remissa, H. adusta, H. genistæ, Euplexia lucipara, Apamea nictitans, A. didyma, Miana literosa, M. strigilis, M. minima, Scotophila porphyrea, Miselia compta, Polia occulta, P. herbida, P. chi, Acronycta menyanthidis, Thyatira batis, Xanthia gilvago, Leucania comma, Cucullia absinthii, Plusia iota, P. percontationis, Heliothis peltigera, &c.*—P. J. S.

BOTANICAL.

Botanical Society of London.—By the advice and sanction of some eminent botanists, it is proposed to form a Society under the above name; the objects

of which are, the advancement of Botanical Science in general, but more especially Descriptive and Systematic Botany, by the reading of original and other papers, on the habitats, particular characters, &c. of Plants, by the formation of a Library, Museum, and Herbarium, for reference and exchange of specimens.

Several gentlemen, friendly to such a society, have held some preparatory meetings, and drawn up regulations for its Government.

It is proposed that ladies be admitted members, with a full participation in the advantages of the Library, &c.—W. M. Chatterley, *Hon. Sec. pro tem.*

Botanical Society of Edinburgh.—April 14, Professor Graham in the Chair. The first meeting held to-day. The Society occupied in making the preliminary arrangements for its future proceedings.

May 12, Professor Graham in the Chair. Mr Carpenter read a communication on the connection between electricity and vegetable life. He commenced by pointing out the differences between the phenomena manifested in living beings, and those which occur in the inorganic world; and argued that their differences arise not from a *change* in the agents immediately concerned in producing the result in both cases, but from these agents being subjected in organized beings to a higher control, that of vitality. He then endeavoured to show the probability that electricity, which is now recognized as the source of chemical affinity, is applied in the vegetable structure to produce the class of compounds usually termed *organic*. The different modes in which electricity is excited during the various processes of vegetable growth, and the experimental indications of its developement, were next enumerated; and the paper was terminated by some hypothetical views regarding the food of plants, based upon the foregoing facts.

Dr Graham stated, that some seeds from a specimen of *Primula*, brought from Norway by Mr Forbes, and named by Somerfeldt *Primula farinosa*, var. *alpina*, had germinated in the Botanic Garden, and two specimens had produced flowers. The examination of these, he said, had satisfied him that they could only be considered a slight variety of *P. Scotica*, differing in no respect from the Sutherland and Caithness-shire specimens, except in the colour of the flower being paler, the tube a little longer, and rather more slender, and the calyx elliptical rather than ovate. Mr Forbes's specimens were gathered in the subalpine country by the Lake of Viger in Lom, and were quite different from *P. stricta* of Horneman, as appeared by specimens of that plant in Dr Graham's Herbarium from Horneman himself.

Mr Tyacke exhibited specimens of *Lamium intermedium*, Fries. lately found by him in several localities in the neighbourhood of Edinburgh, and pointed out the difference between it and *L. incisum* and *L. purpureum*, with the latter of which it seems to have been hitherto confounded.

June 9, Professor Graham in the Chair. Paper by Mr James M'Nab, giving an account of an excursion in the Alleghany mountains in September 1834. The *Rhododendrons*, *Kalmias*, *Azaleas*, and *Andromedas* were particularly mentioned as remarkable for their size and age, Sections of many of these were exhibited, in some of which the concentric circles could be counted to the number of 120.

Mr Forbes read a notice regarding a *Viola* found by him in the Isle of Man, and in several localities in the neighbourhood of Edinburgh, which he referred to

" *Viola ericetorum*, Schrad. *V. canina* γ. Reich. (whose *V. canina* is not that of British and other authors,) perhaps *V. pumila* of Villars, and in all probability *V. montana* of Linnaeus." He stated that it differed from *V. flavicornis* of Smith in many respects; in habit appearing to be intermediate between *V. canina* and *V. lactea*. The form of the filamental glands, he seemed to think, and their relation to the spur, would afford excellent characters for distinguishing the species in the genus *Viola*, although no author appeared to have regarded them in that light.

Dr Balfour exhibited *Ononis reclinata* in flower, raised from seeds brought from Galloway last year.

July 14, Mr Carpenter read some observations on the structural analogies between the animal and vegetable kingdoms, in which he endeavoured to show the correspondence between the principal groups of each; and to apply to plants the laws of development which have been established by the investigation of the structure of animals.

Drs Graham and Balfour gave the following new localities for the plants after mentioned. *Habenaria chlorantha*, near Airdrie, and on the Pentland Hills abundant. *Asperugo procumbens*, field near Luffness. *Specularia hybrida*, near Dirleton and Luffness,—in the latter place abundant. *Trientalis Europaea*, near Dalmahoy Hill, found by Dr Parnell. *Corallorhiza innata*, wood near Currie. *Alyssum calycinum*, discovered in Leicestershire, by the Rev. A. Bloxam.

Philosophia Botanica.—Professor Link intends publishing a new edition of his Philosophia Botanica; and as a separate work, but in illustration of it, he is preparing some plates, to be published under the title of " Icones *Anatomico-botanicæ*."—Comp. to Bot. Mag. ii. p. 76.

Willdenowian Herbarium.—This is arranged on paper of a size between that of the Linnæan (a small foolscap) and other old Herbaria, and the present usual size, (sixteen and a-half inches long, by ten and a quarter broad.) Each specimen is fastened down by strips of paper to a single sheet, and all those that Willdenow had left under one cover, as one species, are carefully put together into a neat double sheet of blue paper. The labels, written by Willdenow, not having been attached by him to individual species, but left loose in the covers, have been fastened to the new covers, which have also a number, beginning from the commencement in the order of his species, and the individual sheets in each cover are also numbered; so that in referring to any specimen in the Herbarium, it is henceforth identified by quoting the number of the specific cover, and that of the sheet on the cover. I have been particular in describing this, because it appears to me to be the most useful way of preserving those Herbaria of distinguished botanists which serve as authorities for their works, and would be far better than the slovenly manner in which Linnæus, Sibthorp's, and others of our Herbier's types are allowed to remain. As to the plants themselves in Willdenow's Herbarium, there are, perhaps, not quite so many as one might have expected; often bad specimens, and unfortunately in many instances, additional specimens have been thrown into the old covers by him without examination, and the labels mixed so that it would require much caution in ascertaining which was the individual specimen the author had in view. But it

is very valuable in containing nearly the whole of the plants he described from the Berlin garden, as well as the oriental plants described in his "Species Plantarum," from Gundelshiemer's and Tournefort's specimens, and the Siberian ones from Stephen; the latter are beautiful specimens, and some of them little known, even now, by Russian botanists. This Herbarium also contains a tolerable set of Humboldt's plants.—Comp. to Bot. Mag. ii. p. 75.

Helvella elastica, Eng. Fl. V. ii. 184.—Some fine specimens of this rare fungus have been sent me from the Hirsel woods, Berwickshire, by Miss Elizabeth Bell of Coldstream. Dickson mentions it as a native of Scotland, but the above is the only Scotch *habitat* which has hitherto been recorded.—G. J.

New Botanical Work.—Sir W. Jackson Hooker has commenced a new botanical work entitled "Icones Plantarum rariorum vel minus cognitarum ex herbario Hookeriano selectæ."—The rich collections, made in all parts of the world, which compose the author's herbarium, will ensure an ample supply of subjects; among which, preference will, of course, be given to those that are most remarkable for their novelty, their structure, or their history; particularly from the vast treasures that have been sent to this country by Dr Wallich and Dr Wight, from the East Indies; by Colonel and Mrs Walker from Ceylon; by the Messrs Cunningham, Baxter, Gunn, and Lawrance, in Australia and New Zealand; by Messrs Gillies, Tweedie, Cuming, Mathews, Bridges, &c. in South America; and by Messrs Drummond, Douglas, and Tolmie, in the Northern part of the New World; besides many collections of minor extent, but not of less importance, on account of the rarity of the species, from other celebrated botanists and travellers. An ardent desire to promote the cause of his favourite science has alone induced Sir W. J. Hooker to undertake this work, certainly not the expectation of any pecuniary advantage; for even should the publication meet with the success that his fondest wishes might anticipate, yet the price set upon it is so low as to forbid any hope of profit; and he is anxious to express his acknowledgments to the publishers, Messrs Longman and Co. for kindly guaranteeing him against any positively pecuniary risk in the undertaking. Under their auspices, it is intended that the work shall extend at least to 200 plates, 8vo, to be published quarterly, in Parts, each consisting of 50 beautifully executed Lithographic Plates, and as many leaves of Letter-press, so that the plates and descriptions may be afterwards arranged in whatever manner the possessor may prefer: price 14s. each Part.

MISCELLANEOUS.

Rev. Dr Carey.—Of this eminent missionary and oriental scholar, a Memoir has been recently published* which, in our opinion, is scarcely worthy of the man, and will, in an especial manner, disappoint those who were aware of his love of natural history, and of his great attainments in Indian botany. The only paragraphs in the volume relating to the subject are the three following, written by his son and which we extract entire, certain to give, in doing so, a gratification to many of our readers.

* Memoir of William Carey, D. D. late Missionary to Bengal, &c. by Eustace Carey. Lond. 1836. 8vo.